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HEN MANURE AS A SUPPLEMENT TO A RATION FOR GROWING CHICKS[1]

TEOFILO A. ZAMUCO

WITH ONE TEXT FIGURE

On the twelfth week of the study the lot fed with hen manure had an average weight of 832.6 grams, and the control, 782.0 grams. The difference was not significant. The chicks fed the unsupplemented College ration had a higher mortality rate (20.6 per cent) than those which received the manure-supplemented ration (15.4 per cent). The amount of basal ration required to grow 1 kilogram weanling weight was 4.4 kilograms, costing ₱1.26; of supplemented ration, only 3.9 kilograms, costing ₱1.03.

Lamoreux and Schumacher (1940) reported that hen feces contained more riboflavin than the amount present in the feed given to the birds. This was later explained by Schumacher and Heuser (1941) as due to an organism capable of synthesizing riboflavin in hen feces.

Bird and Marvel (1943) stated that the increased hatchability of eggs from hens raised in floor-littered pens could be due to the consumption by the hens of their droppings since the feeding of 10 per cent dried feces to hens kept in batteries increased the hatchability of the eggs produced.

Rubin, Max, Bird, and Rothchild (1946) observed that "animal protein factor" was present in hen feces, and McGinnis *et al.* (1947) reported that incubating hen feces for 72 hours at 30°C. stimulated further synthesis of the factor.

Halbrook *et al.* (1950) isolated from droppings microorganisms responsible for the production of vitamin B_{12}.

To determine the influence of dried hen manure when used as a supplement in the College all-mash ration for growing chicks, this study was conducted in the poultry laboratory of the Department of Animal Husbandry from July, 1953, to June, 1954.

MATERIALS AND METHODS

In this study, 300 S.C. White Leghorn chicks produced by the College flock were used in three 12-week trials. One hundred chicks equally divided into two lots were used in each trial. The first trial was conducted from July 11 to October 3, 1953; the second, from September 12 to December 5, 1953; and the third, from October 13, 1953, to January 5, 1954.

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[1] Central Experiment Station Contribution No. 1828. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1954. Prepared in the Department of Animal Husbandry under the direction of Instructor A. C. Campos.

In every trial the chicks in each lot were wingbanded and weighed a few hours after they had been hatched. Weekly weighings were made thereafter until the end of the study. The birds were raised in electrically heated battery brooders during their first five or six weeks of life and later transferred to outdoor unheated cages where they remained until the end of the 12-week period.

The College all-mash chick ration composed of the following ingredients, all parts by weight, was given to the chicks throughout the entire observation period:

Rice bran (fine)	55
Ground corn	20
Fish meal	20
Copra meal	5
	100

One part of common table salt was added to every 100 parts of the ration.

The ration was given to both lots in dry form. Water was accessible to the birds whenever they wanted it. From the fourth week of age of the chicks, ground shells and grit were made available to them at all times. In addition, finely chopped green feed, mostly ipil-ipil (*Leucaena glauca* Linn.) leaves, was hand-fed to them three times a week. Except for the dried hen manure supplement given to lot II in the proportion of 10 parts to 90 parts of the mash, practically identical feeding, treatment, and care were given to the chicks of both lot I (the control) and lot II.

The initial and weekly weights of the individual birds, the amount and cost of feed consumed, the rate of mortality, and some minor observations were recorded.

RESULTS AND DISCUSSION

Rate of growth and mortality. At the start of trial 1, the chicks of lot I were lighter by only 0.7 gram than those of lot II (table 1 and fig. 1). The weight advantage of the experimental birds, however, was not only maintained but even increased up to the end of the feeding period. In the second trial, the chicks in lot I were heavier than those in lot II by 0.1 gram. From the end of the first week up to the twelfth week, however, the chicks in lot II became heavier than those in lot I. In trial 3 the average initial weight of the chicks in lot I was lighter by 0.6 gram than that of the chicks in lot II. As in trials 1 and 2, the chicks in lot II were consistently heavier than those in lot I during the entire period of the experiment. The final average weights indicated a difference of 50.6 grams in favor of lot II.

There were no significant differences between the mean weights of the two lots in all the trials. This finding, contrary to what

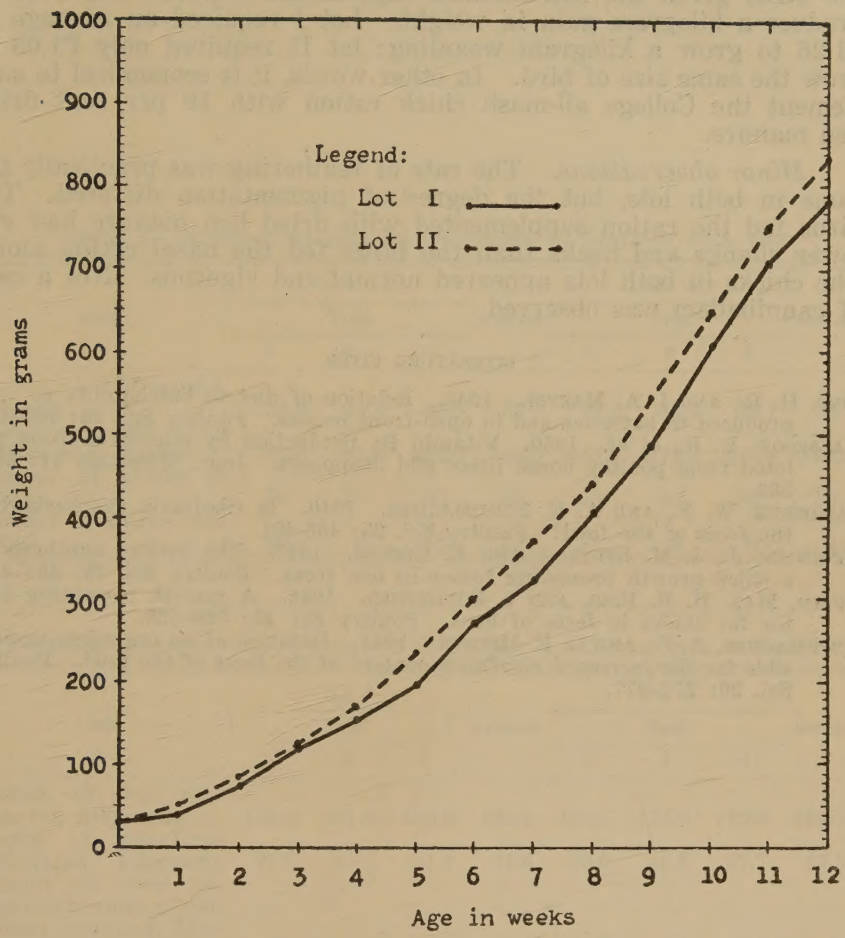

Fig. 1.—Average rates of growth in the three trials.

figure 1 seems to indicate, does not warrant any conclusion as to the relative merits of the two rations.

Out of 150 chicks used in all the trials, 119 birds survived in lot I and 127 in lot II (table 1). The death rate was 20.6 per cent for lot I and 15.4 per cent for lot II.

The incidence of roup might account for the high mortality in some of the trials. The disease was not checked by the administration of Sulmet.

Amount of feed required to produce a kilogram gain in weight. On the average, the experimental birds consumed more feed than the control during the entire feeding period (table 2). On the basis of efficiency in converting the feed consumed into gain in weight,

the birds given the hen manure supplement required less feed to produce a kilogram gain in weight. Lot I required an average of ₱1.26 to grow a kilogram weanling; lot II required only ₱1.03 to grow the same size of bird. In other words, it is economical to supplement the College all-mash chick ration with 10 per cent dried hen manure.

Minor observations. The rate of feathering was practically the same in both lots, but the degree of pigmentation differed. The birds fed the ration supplemented with dried hen manure had yellower shanks and beaks than the birds fed the basal ration alone. The chicks in both lots appeared normal and vigorous. Not a case of cannibalism was observed.

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TABLE 1.—*Average weights and mortality of birds in both lots*

ITEM	LOT I			AVERAGE	LOT II			AVERAGE
	Trial				Trial			
	1	2	3		1	2	3	
Average initial weight, grams	34.2	34.4	33.5	34.0	34.9	34.3	34.1	34.4
Average weight after 12 weeks, grams	791.5	926.2	628.0	782.0	847.0	974.4	676.6	832.6
Number of chicks at start	50	50	50	50	50	50	50	50
Number of chicks that died	10	5	16	10.3	11	3	9	7.7

TABLE 2.—*Amount of feed required to produce a kilogram gain in weight*

ITEM	LOT I			AVERAGE	LOT II			AVERAGE
	Trial				Trial			
	1	2	3		1	2	3	
Amount of feed consumed, kilograms	125.5	151.8	120.9	132.7	125.7	154.6	123.3	134.5
Weight of weanlings produced, kilograms	31.7	41.7	21.4	31.6	33.0	45.8	27.7	35.5
Amount of feed required to raise a kilogram weanling, kilograms	4.0	3.6	5.6	4.2	3.8	3.4	4.5	3.8
Cost of feed required to grow a kilogram weanling, pesos [a]	1.20	1.08	1.68	1.26	1.03	.92	1.22	1.03

[a] Cost of a kilogram of feed: Lot I, ₱0.30; Lot II, ₱0.27.

AMOUNT AND DURATION OF CONCENTRATE CONSUMPTION BY HORSES [1]

VALENTE VILLEGAS [2]

The mean amount of concentrate eaten by eight mature horses was 2.6 ± 0.4 kilograms a day: 54.9 ± 1.6 per cent in the morning and 45 ± 1.6 per cent in the afternoon. The mean amount of concentrate taken per 100 kilograms of live weight was 1.0 ± 0.2 kilograms. The mean duration of feeding was 43.2 ± 9.3 minutes in the morning and 40.3 ± 8.7 minutes in the afternoon. In the morning, the mean amount consumed a minute was 40.0 ± 7.0 grams, and in the afternoon, 37.2 ± 6.2 grams. The mean feeding duration during the day was 83.5 ± 17.8 minutes. The mean amount of concentrate consumed a minute during the day was 38.7 ± 6.6 grams.

The objects of this investigation were to estimate the amount of concentrate a horse can consume at full feeding and to determine the duration of such feeding. The work was conducted in the Department of Animal Husbandry from January 5, 1947, to November 28, 1949.

MATERIALS AND METHODS

Eight mature horses, two males and six females, were used in the work. They ranged in weight from 175 to 395 kilograms, the average weight being 261.3 kilograms.

A total of 174 determinations—from 15 to 44 with each horse—was made. The horses were fed a concentrate mixture of equal parts by weight of ground corn, fine rice bran, and copra meal at approximately eight o'clock in the morning and one o'clock in the afternoon. Before and after feeding, soilage of mixed grasses and *Centrosema pubescens* Benth. was given them *ad libitum*. Water and salt were provided in separate containers. In determining the consumption capacity of horses, only feedings with leftovers were considered. In determining the duration of feeding, however, all feedings were considered.

DISCUSSION OF RESULTS

Amount of concentrate consumed. In the morning, each horse consumed as little as 0.4 kilogram of concentrate and as much as 3.3 kilograms (table 1). The means ranged from 0.7 ± 0.1 to 2.8 ± 0.2 kilograms a head. The amount eaten in the morning varied from 50.0 to 62.5 per cent of the daily consumption, the mean being 54.9 ± 1.55 per cent.

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[1] Central Experiment Station Contribution No. 1829.

[2] The assistance of Messrs. Marcelino Recio and Jacinto L. Gallardo in this investigation is acknowledged.

In the afternoon, the amount of concentrate consumed ranged from 0.3 to 3.6 kilograms. The mean consumption of each horse was from 0.7 ± 0.1 to 2.2 ± 0.29 kilograms. The afternoon feed was from 37.5 to 50.0 per cent of the daily consumption, the mean being 45.1 ± 1.56 per cent.

The total amount of concentrate consumed varied from 1.4 to 5.0 kilograms a day, the mean being 2.6 ± 0.43 kilograms.

Computed on the basis of 100 kilograms live weight, the range was from 0.6 to 1.7 kilograms and the mean was 1.0 ± 0.2 kilograms.

Duration of feeding. The variation in the duration of feeding in the morning was from 20.2 to 99.2 minutes, the mean being 43.2 ± 9.3 minutes (table 2). In amount of concentrate consumed a minute, the range was from 21.6 to 79.2 grams, the mean being 40.0 ± 7.0 grams.

In the afternoon, the length of feeding fluctuated from 16.9 to 89.5 minutes, the mean being 40.3 ± 8.7 minutes. The amount of concentrate eaten by each horse ranged from 21.7 to 71.0 grams a minute, the mean being 37.2 ± 6.2 grams.

During the day, the minimum feeding duration was 37.1 minutes; the maximum, 188.7 minutes. The mean was 83.5 ± 17.8 minutes. The amount of concentrate consumed a minute varied from 24.1 to 75.5 grams, the mean being 38.7 ± 6.6 grams.

TABLE 1.—*Amount in kilograms of concentrate consumed by horses*

NAME OF HORSE	NO. OF TRIALS	MORNING			AFTERNOON			TOTAL CONSUMPTION	AMOUNT OF CONCENTRATE CONSUMED PER 100 KILOGRAMS LIVE WEIGHT
		Range	Mean	Percentage of total amount	Range	Mean	Percentage of total amount		
Baya	15	0.4–0.9	0.7 ± 0.06	50.0	0.3–0.9	0.7 ± 0.07	50.0	1.4	0.6
Bayog	21	1.1–1.9	1.3 ± 0.07	52.0	1.0–1.6	1.2 ± 0.06	48.0	2.5	1.3
Malaya	20	1.0–1.8	1.5 ± 0.08	62.5	0.5–1.1	0.9 ± 0.09	37.5	2.4	0.9
Maligaya	44	0.7–1.9	1.2 ± 0.08	54.5	0.3–1.5	1.0 ± 0.09	45.5	2.2	0.8
Malvarosa	14	1.8–3.3	2.8 ± 0.22	56.0	1.1–3.6	2.2 ± 0.29	44.0	5.0	1.7
Mars	22	0.9–2.2	1.6 ± 0.13	57.1	0.9–1.7	1.2 ± 0.11	42.9	2.8	0.7
Putha	22	0.5–1.4	1.1 ± 0.10	52.4	0.8–1.3	1.0 ± 0.09	47.6	2.1	—
Mean				54.9 ± 1.56			45.1 ± 1.56	2.6 ± 0.43	1.0 ± 0.17

TABLE 2.—*Duration of concentrate feeding*

NAME OF HORSE	NO. OF TRIALS	MORNING			AFTERNOON			DURING THE DAY		
		Amount consumed	Feeding period	Amount consumed a minute	Amount consumed	Feeding period	Amount consumed a minute	Amount consumed	Feeding period	Amount consumed a minute
		kg.	*minutes*	*g.*	*kg.*	*minutes*	*g.*	*kg.*	*minutes*	*g.*
Baya	15	0.7	32.4	21.6	0.7	25.6	27.3	1.4	58.0	24.1
Bayog	21	1.3	48.3	26.9	1.2	50.6	23.7	2.5	98.9	25.3
Malaya	20	1.5	57.7	26.0	0.9	41.5	21.7	2.4	99.2	24.2
Maligaya	44	1.2	20.3	59.1	1.0	18.6	53.8	2.2	38.9	56.6
Malvarosa	14	2.8	99.2	28.2	2.2	89.5	24.6	5.0	188.7	26.5
Mogina	16	1.5	41.9	35.8	1.9	55.3	34.4	3.4	97.2	35.0
Mars	22	1.6	20.2	79.2	1.2	16.9	71.0	2.8	37.1	75.5
Putha	22	1.1	25.3	43.5	1.0	24.6	40.7	2.1	49.9	42.1
Mean		1.5±0.22	43.2±9.32	40.0±7.04	1.3±0.18	40.3±8.70	37.2±6.15	2.7±0.38	83.5±17.76	38.7±6.62

THE SWINE INDUSTRY IN BUKIDNON [1]

AMANTE P. CABOTAJE

Of 255 swine raisers interviewed in Bukidnon about half were housekeepers. Most of the raisers kept hogs both for home consumption and for sale. About 71 per cent raised them for growing and fattening purposes. Breeding stock and purebred swine were not raised. The most common breed raised was the native or "Bisaya."

About one-half of the swine raisers kept their hogs in barns, the average size of which was 48 square meters. The common types of hog houses were gables and sheds. About 61 per cent of the swine raisers followed the concentrate-pasture system of feeding. Feed was given as slop on about 62 per cent of the farms. Cooked feed was used on 19 per cent. About 18 per cent of the farms used both methods. The slit method of castration was used. About 77 per cent used knives or blades in making the incision, and about 64 per cent used kerosene and ashes for treatment.

The swine raisers usually mated their sows to their own boars or to their neighbors'. Only about 6 per cent bred their sows in the government breeding station. The proportion of pigs born alive to those born dead was 9:1. The average number of pigs to a litter was 8.4. Seventy-three per cent of the pigs born alive were raised to weaning age.

Eighty-six swine owners, or about 34 per cent, reported the absence of diseases on their farms. Weanlings and sucklings easily succumbed to coughing and purulent conjunctivitis. Only 13 farmers, or about 5 per cent, reported cases of hog cholera.

Swine are the most important food animals in the Philippines, both in terms of number and general widespread distribution. Although production is not as good as it should be, recommendations for improvement cannot be made until the exact state of the industry is known.

THE SURVEY AREA

For such information a field survey was made in barrios of three municipalities in Bukidnon. The barrios surveyed were Sampiano, Kalugmonon, Kalaniogan, Minsuro, and Tankulan in the municipality of Maluko in the north; Dalwangan, Impalambong, Basak, Alanib, Mailag, and Valencia in Malaybalay in the central area; and Palma and Kadingilan in Kibawe in the south (table 1).

Bukidnon is located in North Central Mindanao. Its main sources of livelihood are livestock raising and farming. The principal crops grown are corn, rice, and abaca. Cattle are raised on a commercial basis. Swine and poultry are kept for home consumption

[1] Central Experiment Station Contribution No. 1830. Taken from a thesis presented for the degree of Bachelor of Science in Agriculture from the College of Agriculture, November, 1954. Prepared in the Departments of Animal Husbandry and Agricultural Economics under the direction of Visiting Professor C. D. Kearl and Dr. Valente Villegas.

TABLE 1.—*Number of barrios and poblacions and farmers*

LOCATION	NUMBER	
	Barrios and poblacions	Farmers interviewed
North area	5	55
Central area	7	150
South area	3	50
Total	15	255

as well as for sale. Corn is the main food of the people. Rice is usually grown in the uplands as a substitute for corn.

The population is made up mainly of Visayans, Ilocanos, and Tagalogs. The natives of Bukidnon, the Binukidnons, the Manubos, and the Moros, lead a nomadic life and do not raise hogs. Furthermore, the Moros abstain from eating pork for religious reasons.

THE SWINE RAISERS

Most of the swine raisers surveyed had been in the business for a relatively short time. Of the 255 studied, about 44 per cent had been engaged in swine raising for only one to four years and about 34 per cent, five to nine years. Only 22 per cent had raised swine for as long as ten years.

About half of the swine raisers were women. Thirty-two per cent were farmers and the remainder were teachers, merchants, and the like (table 2).

TABLE 2.—*Occupation of swine raisers*

OPERATOR	PER CENT			
	North area	Central area	South area	All areas
Farmers	36	32	28	32
Housekeepers	51	43	54	47
Teachers	5	7	6	6
Merchants	—	7	2	5
Others	8	11	10	10
Total	100	100	100	100

About 95 per cent of the hogs in the central area and about 80 per cent in the south were raised for home consumption and for sale (table 3). In the northern area about one-half of the persons interviewed raised swine for home consumption only. Bad roads and lack of transportation facilities made it difficult for the farmers from isolated barrios in the northern area to market their hogs.

Of all the swine raisers interviewed, about 80 per cent raised hogs for home consumption and for sale, and about 20 per cent for

TABLE 3.—*Purpose in raising swine*

PURPOSE	PER CENT			
	North area	Central area	South area	All areas
Home use only	58	5	18	19
Home use and for sale	40	95	80	80
Other	2	—	2	1
Total	100	100	100	100

home consumption only. None was engaged in swine raising solely on a commercial basis.

THE SWINE

In the northern and southern areas 95 per cent of the interviewees raised swine for both growing and fattening purposes (table 4). In the central area, the percentage was only about 54. Breeding stock was raised by only about 16 per cent of the producers.

TABLE 4.—*Classes of hogs raised*

CLASS	PER CENT			
	North area	Central area	South area	All areas
Growing and fattening hogs	98	54	94	71
Butcher stock	—	27	2	16
Breeding stock and purebreds	—	—	—	—
Combinations	2	19	4	13
Total	100	100	100	100

Breeds. About 73 per cent of the farmers raised only the native ("Bisaya") breed (table 5). Crossbreeds of native and European hogs were raised by 27 per cent of the producers. No one reported owning a hog of the Berkjala breed.

TABLE 5.—*Breeds of hogs raised*

BREED	PERCENTAGE OF SWINE RAISERS			
	North area	Central area	South area	All areas
Native	93	60	82	71
Native–Berkshire	—	23	8	15
Native–Poland China	5	8	6	7
Native–Duroc Jersey	—	7	2	5
Combinations [a]	2	2	2	2
Total	100	100	100	100

[a] Farmers had both pure native and pure Berkshire, Poland China, and Duroc Jersey breeds.

Number and value. About six hogs were kept on a farm (table 6). These consisted on the average of a sow, a barrow, two weanlings, and a suckling. A few farmers had boars, stags, and gilts. The value of the swine was ₱101.16 to a farm. The largest investment was in sows and barrows.

TABLE 6.—*Number and value of swine*

KIND	AVERAGE TO A FARM FOR YEAR	
	Number	Value
Boar	0.2	₱ 3.49
Sow	0.9	36.24
Barrow	1.0	39.68
Stag	0.2	0.35
Gilt	0.5	18.58
Weanling	1.5	3.30
Total	6.1	₱101.16

Most of the swine on the farms came from the farmers' own herds. Only 0.2 swine to a farm was purchased during the year. This was usually a weanling pig.

SWINE MANAGEMENT

Where kept. About one-half of the swine raisers housed their swine in barns, and one-fourth let their hogs run loose (table 7). Others tied their hogs near the house.

TABLE 7.—*Place where swine was kept*

PLACE	PERCENTAGE OF FARMERS			
	North area	Central area	South area	All areas
Hog pen	20	56	44	46
Tied near house	24	13	6	14
Pasture	4	2	—	2
Left loose	38	13	38	23
Combination of any of the above	14	16	12	15
Total 100	100	100	100	100

Only 139 farmers had hog houses. The common types of hog houses, in almost equal proportion, were gables and sheds (table 8). The average size of the hog barns was 48 square meters. The hog houses in the central area were considerably larger than those in the northern or southern areas.

Feeding. Concentrate-pasture, the most common system of feeding used, was practiced by about 61 per cent of the swine raisers (table 9). No pasturing problems were reported. About 19 per cent used the concentrate-soilage system of feeding; about 12 per cent, the dry-lot system; and about 8 per cent, a combination of these

TABLE 8.—*Types of hog barns*

TYPE	PERCENTAGE OF HOG HOUSES			
	North area	Central area	South area	All areas
Gable	31	56	50	52
Shed	69	42	50	46
Gable and shed	—	2	—	2
Total	100	100	100	100

systems. The concentrate-pasture system was more common in the northern area, with 91 per cent of the farms using the method. Only one-half of the farms used it in the central area.

TABLE 9.—*Systems of feeding*

SYSTEM	PERCENTAGE OF FARMS			
	North area	Central area	South area	All areas
Concentrate–pasture	91	50	62	62
Concentrate–soilage	2	21	32	19
Dry lot	5	17	2	11
Combinations	2	12	4	8
Total	100	100	100	100

More than one-half of the swine raisers gave feed as slop (table 10). About one-fifth cooked the feed, and another one-fifth used a combination of these ways. The feed was never given raw. Hand-feeding was followed by all the swine raisers. Self-feeding or free choice was not practiced. A larger proportion of the farmers fed slop to the swine in the northern area than elsewhere.

TABLE 10.—*Feed preparation*

PREPARATION	PERCENTAGE OF FARMERS			
	North area	Central area	South area	All areas
Slop	91	52	62	62
Cooked	2	27	14	20
Raw	—	—	—	—
Combination	7	21	24	18
Total	100	100	100	100

No farmer fed his swine only once a day. About 95 per cent fed their swine in the morning and in the afternoon. Only 4 per cent gave three feedings a day. One per cent did not follow a definite feeding schedule.

Kitchen refuse was a part of the feed given to the swine on about 97 per cent of the farms (table 11). Corn bran was used on about 79 per cent of the farms; "kiskis" rice bran, on 55 per cent;

shelled corn, on 49 per cent; whole ear corn, on 37 per cent; and rice bran from pounded palay, on 10 per cent of the farms. A few swine were fed ground corn and fine "Cono" rice bran.

TABLE 11.—*Kinds of feeds used*

KINDS [a]	PERCENTAGE OF FARMERS			
	North area	Central area	South area	All areas
Concentrate:				
Whole ear corn	15	39	52	36
Shelled corn	29	59	30	49
Ground corn	—	8	2	5
Fine "Cono" rice bran	2	5	—	3
"Kiskis" rice bran	13	80	28	55
Rice bran from pounded palay	13	18	2	10
Corn bran	96	66	100	79
Kitchen refuse	98	97	100	97
Roughage:				
Sweet potato vines	11	34	42	31
Kangkong	—	2	22	31
Papaya	—	16	—	10
Banana stalk and others	11	32	34	28

[a] Feeds were in varying combinations. The average price of one sack (25 kg.) of corn ears was ₱3.00; one sack (58 kg.) of shelled corn, ₱6.50; one sack (25–30 kg.) of "kiskis" rice bran, ₱1.50; one sack (40 kg.) of corn bran, ₱2.00; and one sack (58 kg.) of ground corn, ₱7.50.

Sweet potato vines, kangkong, cooked chopped green papaya fruits and banana stalks were used as roughage. Sweet potato vines and kangkong were fed as soilage.

Breeding. In general, as noted previously, the swine came from the farmers' own herds. Of these breeding animals, boars were kept for a relatively short time (table 12). Only about 46 per cent of the

TABLE 12.—*Length of time boars and sows were kept* [a]

YEARS	FARMERS							
	North area		Central area		South area		All areas	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Boars								
1	1	20	5	19	—	—	6	15
2	—	—	9	33	3	42	12	31
3	3	60	13	48	2	29	18	46
4	1	20	—	—	2	29	3	8
Total	5	100	27	100	7	100	39	100
Sows								
1	2	7	2	2	—	—	4	2
2	3	11	5	44	2	8	10	6
3	6	22	24	21	4	16	34	21
4	2	7	13	12	—	—	15	9
Indefinite	14	53	68	21	19	76	101	62
Total	27	100	112	100	25	100	164	100

[a] Only 164 farmers owning boars and sows gave reports.

swine raisers who owned boars kept them for as long as three years; 31 per cent, for only two years; and 15 per cent, for only one year. More than one-half kept their sows for as long as the breeding performance was satisfactory.

About 9 per cent of the farmers in the central area bred their sows in the Malaybalay Stock Farm, the only animal breeding station in Bukidnon (table 13). The station is centrally located and charges a reasonable fee of ₱5.00 for each mating. It is unfortunate that such a high proportion of the swine owners bred their sows to their own boars or to those of other farmers and did not take advantage of the breeding facilities at the government station.

TABLE 13.—*Where sows were bred*

WHERE SOWS WERE BRED	NORTH AREA		CENTRAL AREA		SOUTH AREA		ALL AREAS	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Government [a]	—	—	11	9	1	2	12	6
Private [b]	1	3	15	13	10	23	26	13
Farmer [c]	18	45	70	58	19	44	107	53
Stray	21	52	24	22	13	31	58	28
Total	40	100	120	100	43	100	203	100

[a] Service fee was ₱5.00 for each mating.
[b] Service fee was ₱5.00 or one weanling for each mating.
[c] Service fee was one weanling for each mating boar owned by the other farmer.

At the time of the survey, a 4-H club organized by the Bureau of Agricultural Extension purchased two Berkshire boars. To enable all the members of the club to use these boars in breeding work, each boar was left in a barrio or town for one week or more and then taken to another place.

The average number of pigs to a litter was 8.4 (table 14). About 93 per cent of the pigs were born alive.

TABLE 14.—*Breeding performance of sows* [a]

PIGS	NORTH AREA	CENTRAL AREA	SOUTH AREA	ALL AREAS
Pigs to a litter	8.3	8.5	8.1	8.4
		Per cent		
Raised to weanling age [b]	80	74	66	73
Born	100	100	100	100
Alive	90	95	93	94
Born dead	10	5	7	6

[a] During the year 175 sows, or 72 per cent of the total number, farrowed.
[b] Based on 91 sows that weaned their pigs.

Seventy to eighty per cent of the pigs in the area were raised to weaning age. The mortality rate of the pigs born alive was about 27 per cent. Two-thirds of the pigs from 91 sows owned by 60 swine raisers were weaned in three months or less (table 15).

TABLE 15.—*Weaning age of pigs* [a]

MONTHS	PERCENTAGE OF PIGS			
	North area	Central area	South area	All areas
2	—	4	—	3
2½	80	69	69	69
3	—	17	—	13
3½	20	4	12	7
4	—	6	19	8
Total	100	100	100	100

[a] Based on 91 sows that weaned their litters.

Method of castration. The slit method of castration was employed by all of the swine raisers. Knives or blades were used by most farmers to make the incision and to cut the spermatic cord; pieces of sharp bamboo were used by about 33 per cent (table 16). Out of 140 swine raisers in the central area, only 41, or about 30 per cent, used iodine and pine tar as disinfectant. The less effective way of disinfecting with kerosene and ashes was a common practice in all the areas. It was used in about three-fourths of the cases in the northern and southern areas and in about 33 per cent of the cases in the central area.

TABLE 16.—*Methods of castration*

METHOD	FARMERS							
	North area		Central area		South area		All areas [a]	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Slit:								
Sharp bamboo	11	28	25	18	12	34	48	33
Knives or blades	29	72	115	82	23	66	167	77
Total	40	100	140	100	35	100	215	100
Disinfectant:								
Iodine and pine tar	2	5	50	30	—	—	43	20
Kerosene and ashes	31	78	70	53	26	74	132	61
Others	7	17	20	17	9	26	40	19
Total	40	100	140	100	35	100	215	100

[a] Based on reports of 215 farmers.

Hog diseases and mortality. Coughing was reported by about 25 per cent of the swine raisers to be the common disease among the weanlings (table 17). About 5 per cent reported cases of purulent conjunctivitis, and about 5 per cent reported cases of hog cholera. The occurrence of all these diseases on the same farm was reported

by 30 per cent. The other kinds of diseases noted in the survey were reported by only 2 per cent. It is important to note that 33 per cent of the 255 swine raisers did not report cases of hog diseases.

TABLE 17.—*Hog diseases*

DISEASE	PERCENTAGE OF FARMERS			
	North area	Central area	South area	All areas
Coughing	20	22	38	25
Purulent conjunctivitis	5	5	8	5
Hog cholera	18	2	—	5
Combinations of above	9	38	26	30
Others	2	1	2	2
No diseases	46	32	26	33
Total	100	100	100	100

The average number of swine that died was 0.76 to a farm (table 18). This was 12 per cent of the average number to a farm. Two-thirds of the pigs that died were weanlings.

TABLE 18.—*Mortality*

KIND	NUMBER THAT DIED	PERCENTAGE OF AVERAGE
Boar	—	—
Sow	0.07	1.07
Barrow	0.03	0.03
Stag	—	—
Gilt	0.02	0.04
Weanling	0.51	0.42
Suckling	0.13	—
Total	0.76	0.56

Sales. Weanlings made up more than half of the swine sold (table 19). The greatest income, however, came from the sale of barrows. The income from weanlings was second biggest, followed by those from sows and gilts. More weanlings were used at home than any other type of swine. Barrows were a close second. Their value was three times that of the weanlings.

TABLE 19.—*Sale and use*

KIND	SOLD		CONSUMED AT HOME	
	Number	Value	Number	Value
		pesos		*pesos*
Boar	—	0.20	—	0.24
Sow	0.09	4.76	0.04	1.65
Barrow	0.30	12.89	0.27	9.82
Stag	0.01	0.43	—	0.14
Gilt	0.13	4.14	0.14	2.02
Weanling	0.71	7.21	0.31	3.19
Suckling	—	—	—	—
Total	1.24	29.63	0.76	17.06

EXPENDITURES OF 117 MEN STUDENTS IN THE UP COLLEGE OF AGRICULTURE, 1952-53 [1]

L. S. Robertson [2] and N. B. Tablante [3]

The average expenditure of 117 selected freshmen, sophomores, and juniors was ₱967. Food and tuition were the largest items of expense, making up about one-half of the total. The variation in expenses was less among freshmen than among sophomores and juniors. It was greater in medical and dental expenses and luxury items than in standard necessities such as food and lodging. Students who did their own cooking spent less than two-thirds as much for food as students who ate at the College Mess Hall or in the Grove and slightly less than those who boarded in private houses. "Cookers" also spent less than one-half as much as Mess Hall and Grove eaters for refreshments to supplement their meals. Lodging costs were also less for students who did their own cooking or boarded in private homes because some of them worked for part of their lodging. Other costs were associated with eating place.

The average expenditure of 117 randomly selected freshmen, sophomores, and juniors at the UP College of Agriculture for the academic year 1952-53 was ₱967 (table 1). Seventeen of these students worked part time to reduce their cash expenses. The total year's expenses of the other 100 students averaged ₱1014. Food and tuition were the largest items of expense, making up about one-half of the total. Lodging, laundry, clothing, transportation, and refreshments each constituted approximately 1/20 of the total expenses.

VARIATION IN EXPENDITURE

Students varied greatly in their total expenditures. Ten of the 117 spent less than ₱600 each; 11 spent more than ₱1400 each (table 2). The variation was less among freshmen than among sophomores or juniors.[4] After the first year, as the students became more familiar with their surroundings at the College, they evidently tended to act more in line with their individual characteristics and financial abilities, breaking away from the more uniform earlier pattern.

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[1] Central Experiment Station Contribution No. 1831. Summarized by students in agricultural economics statistics at the beginning of the first semester of 1953-54. Only freshmen, sophomores, and juniors were interviewed as most of the seniors were not in the College when the study was made. Read at the 222nd regular scientific meeting of the Los Baños Biological Club.

[2] Former visiting professor of agricultural economics.

[3] Assistant professor of agricultural economics; resigned.

[4] The coefficient of variability (percentage average variation was of the arithmetic mean) was 19 per cent for freshmen, 31 per cent for sophomores, and 25 per cent for juniors.

TABLE 1.—*Average expenditures of 117 men students, UP College of Agriculture, 1952–53*

ITEM	AMOUNT SPENT BY A STUDENT		PERCENTAGE OF TOTAL	
	117 students	100 who did not work	117 students	100 who did not work
Food	₱339	₱ 361	35.1	35.6
Tuition and other fees	162	164	16.7	16.2
Lodging	66	75	6.8	7.4
Laundry	55	56	5.7	5.5
Clothing	52	53	5.4	5.2
Transportation	52	55	5.4	5.4
Refreshments	50	53	5.2	5.2
Movies, prom, and entertainment	37	39	3.8	3.8
Uniforms	25	30	2.6	2.9
Books and equipment	22	21	2.3	2.1
Paper and supplies	21	21	2.2	2.1
Cigarettes	19	20	2.0	2.0
Church, charity, and gifts	17	18	1.8	1.8
Toilet articles	15	16	1.5	1.6
Haircuts	12	13	1.2	1.3
Club dues and fines	5	4	0.5	0.4
Medical and dental expenses	4	4	0.4	0.4
Other expenses	14	11	1.4	1.1
Total	₱967	₱1,014	100.0	100.0

TABLE 2.—*Ranges of total expenditures of 117 men students, UP College of Agriculture, 1952–53*

AMOUNT OF EXPENDITURE	CLASS			ALL
	Freshmen	Sophomores	Juniors	
400–499		3	1	4
500–599		3	3	6
600–699	4	8	3	15
700–799	4	4	4	12
800–899	6	4	5	15
900–999	3	5	7	15
1,000–1,099	8	3	4	15
1,100–1,199	3	2	4	9
1,200–1,299	4	3	3	10
1,300–1,399	1	2	2	5
1,400–1,499	1		3	4
1,500–1,599	1		2	3
1,600–1,699		1	1	2
1,700–1,799				
1,800–1,899				
1,900–1,999				
2,000–2,099		2		2
Total	35	40	42	117

On a percentage basis the variation from the mean of all students was greater in medical and dental expenses than in other items (table 3). The variation was greater among luxury items such as

cigarettes, refreshments, entertainment, and miscellaneous expenditures than among standard necessities such as food and lodging. The variation was smallest in tuition and other fees.

TABLE 3.—*Average variation in items of expense of 117 men students, UP College of Agriculture, 1952–53*

ITEM	AVERAGE EXPENSE	AVERAGE VARIATION FROM MEAN	AVERAGE PERCENTAGE VARIATION FROM MEAN [a]
Tuition and other fees	₱162	₱16.2	10
Food	38	13.6	36
Lodging	7	2.8	40
Transportation	54	28.1	52
Paper and supplies	2	1.3	53
Clothing	52	28.2	54
Haircuts	1	.7	54
Books and equipment	22	12.8	58
Club dues and fines	5	3.2	64
Laundry	6	3.9	65
Uniforms	25	17	60
Toilet articles	2	1.2	75
Church, charity, and gifts	18	14.2	78
Movies, prom, and entertainment	37	29.0	78
Refreshments	5	4.3	86
Cigarettes	2	2.3	115
Miscellaneous expenses	14	17.4	124
Medical and dental expenses	4	7.7	192

[a] Coefficient of variability (V_{AD}). The average expenses were carried to one decimal instead of being rounded to the nearest peso.

CAUSES OF VARIATION

Variation in expenses among students seemed to be largely the result of differences in places of eating and living, in amount of food and clothing received from home or elsewhere, in school expenses associated with the courses being taken, and in personal habits and financial status.

Eating place. Students who did their own cooking, singly or in groups, spent less than two-thirds as much for food as students who ate at the College Mess Hall or in the Grove and slightly less than those who boarded in private homes (table 4). The "cookers" spent less than one-half as much as the Mess Hall and Grove eaters for refreshments to supplement their meals. Students boarding in private homes had comparatively low food expenses probably because some of them worked for part or all of their food.

Lodging costs were also less for students who did their own cooking or boarded in private homes than for those who ate at the Mess Hall or the Grove. Again, some who ate in private homes worked for a part of their lodging.

Other costs than those for food and lodging also were associated with eating place. Total expenses of the "cookers" were only about three-fifths as much as expenses of students who ate in the Grove or at the Mess Hall.

TABLE 4.—*Relation of eating place to costs of food and lodging and to all costs of 117 men students, UP College of Agriculture, 1952–53*

ITEM	EATING PLACE			
	Mess hall	Grove	Own cooking	Others
Number of students	14	32	58	13
Monthly receipts (₱)	93	106	33	58
		Cost of food (pesos)		
35 freshmen	456	459	234	405
40 sophomores	[a]	450	268	216
42 juniors	[a]	404	272	289
All students	456	438	258	303
		Cost of refreshments (pesos)		
35 freshmen	72	53	29	34
40 sophomores	[a]	88	28	49
42 juniors	[a]	82	26	52
All students	72	74	28	45
		Cost of lodging (pesos)		
35 freshmen	89	83	71	59
40 sophomores	[a]	78	55	18
42 juniors	[a]	78	51	45
All students	89	80	59	41
		Total costs for year (pesos)		
35 freshmen	617	595	334	498
40 sophomores	[a]	616	351	283
42 juniors	[a]	564	349	386
All students	617	592	345	389

[a] No sophomore or junior ate at the Mess Hall.

Living place. Yearly expenses averaged lower for students living in cottages (cabins) than for those living in other places (table 5). The biggest saving was in food, as the cottage dwellers cooked their own. Total expenses did not differ significantly for students living in the College dormitory, private dormitories, and miscellaneous places, except that more of the students in the "Bungalows and Others" group worked for part or all of their room or board and therefore spent less in cash.

Monthly receipts. Part of the variation in total expenditures among the students was the result of necessity. Some students had much more to spend than others. About one third of the students had monthly receipts of less than ₱60, another third had from ₱60 to ₱90, and the remaining had more than ₱90. The amount of monthly receipts was related closely to most items of expense, particularly luxury items such as entertainment and cigarettes (table 6). It was related less to tuition, uniforms, and school supplies.

In the relationship of receipts to expenditures, the amount of receipts was partly cause and partly result.

TABLE 5.—*Relation of living place to costs of food and lodging of 117 men students, UP College of Agriculture, 1952–53*

ITEM	LIVING PLACE			
	College dorm.	Private dorm.	Cottages	Bungalows & others
Number of students	19	71	6	21
Monthly receipts (₱)	87	77	60	78
		Cost of lodging (pesos)		
35 freshmen	81	72	45	72
40 sophomores	[a]	72	[a]	90
42 juniors	[a]	81	[a]	63
All students	81	75	45	75
		Cost of food (pesos)		
35 freshmen	387	396	153	342
40 sophomores	[a]	297	279	378
42 juniors	[a]	360	261	351
All students	387	351	231	357
		Total cost (pesos)		
35 freshmen	1034	988	607	871
40 sophomores	[a]	925	551	976
42 juniors	[a]	1013	822	1014
All students	1034	975	660	954

[a] None of the sophomores or juniors stayed in the College dormitory or cottages.

TABLE 6.—*Relation of monthly receipts to items of expense of 117 men students, UP College of Agriculture, 1952–53*

ITEM	MONTHLY RECEIPTS (PESOS)		
	Less than 60	60-90	More than 90
Number of students	39	44	34
		Expenditures	
Food	₱202	₱383	₱ 462
Tuition and other fees	158	169	157
Lodging	42	68	88
Laundry	33	57	78
Clothing	34	49	72
Transportation	35	48	73
Refreshments	20	40	97
Movies, prom, and entertainment	18	27	74
Uniforms	25	22	24
Books and equipment	21	22	67
Paper and supplies	18	18	28
Cigarettes	11	29	41
Church, charity, and gifts	10	18	27
Toilet articles	12	12	24
Haircuts	9	13	15
Club dues and fines	3	5	6
Medical and dental expenses	3	3	6
Other expenses	3	12	18
Total	₱657	₱995	₱1357

DISCUSSION

Students who had the smallest total expenditures tended to be those who cooked for themselves or who worked for all or part of their board. Even though the percentage variability in eating costs was low, the actual variation in number of pesos was large as eating was the largest single item of expense. The majority of the items of expense that varied most on a percentage basis represented such a small total outlay that economizing in any one of them would have had no great effect on the total. But there was an apparent tendency for high expenses in any one luxury item to be associated with high expenditures in other luxury items, and economy in all of the relatively variable small items resulted in considerable saving in total expenditures.

LAND TENURE IN LOS BAÑOS, LAGUNA [1]

RAMON C. ALCACHUPAS

Of the 93 farmers surveyed, 61 were tenants, 19 were part-owners, and 13 were owners. The average size of a farm was 2.73 hectares, of which 1.21 hectares were planted to lowland rice. The average production of lowland rice to a hectare was 28.24 cavans, and that of upland rice was 18.24 cavans. Landlord-tenant contracts were mostly verbal and governed by the customs and traditions of the locality. There was a low percentage of blood relationship between landlords and tenants. Acquisition of farms was by purchase, inheritance, or marriage.

Field investigations and a careful study of prevailing renting practices are the first steps toward developing the broad essentials of a sound and equitable farm tenure system. Such a system should incorporate the desirable features that are in successful operation and should consider the interests of the community as well as those of the tenants and landlords.

THE AREA

The farm tenure on all rice farms in San Antonio, Batong Malake, Anos, and Mayondon, which are adjoining barrios in Los Baños, Laguna, was studied. The area is located between Laguna Bay and the UP College of Agriculture.

Rice is the major farm crop. Lowland rice fields are valued at about ₱3000 per hectare and upland fields at ₱2000 to ₱4000 per hectare. The farms depend entirely upon rain water for irrigation of the fields.

There were 36 rice farms in Barrio San Antonio, 17 in Batong Malake, 27 in Anos, and 13 in Mayondon.

Of the 93 farmers interviewed 61 were tenants, 19 were part-owners, and 13 were owners.

THE FARM OPERATORS

Two-thirds of the farmers were born and grew up in the area in which they now farm (table 1). The proportion was somewhat less for owners than for those renting land. Their ages ranged from 16 to 75 years. The tenants, although younger, had acquired more education than the other groups. The part-owner operators possessed a slightly lower educational attainment than the owner-operators.

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[1] Central Experiment Station Contribution No. 1832. Taken from a thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1954. Prepared in the Department of Agricultural Economics under the direction of Dr. C. D. Kearl.

TABLE 1.—*Characteristics of the farm operators*

ITEM	AVERAGE			
	Tenant	Part-owner	Owner	All farms
Percentage born in the four barrios	69	79	46	67
Age of farmers	35	40	40	36
Highest grade attained	2.6	2.3	2.4	2.5
Years of residence in barrio	28	36	31	31
Years engaged in farming	15	22	21	17
Years operating present farm	6	8	9	7

In general the part-owners and owners had been in farming longer than the tenant operators. Tenancy is evidently a step for many farmers in starting to farm. The owner-operators and part-owners had been operating their farms for a longer period than the tenants.

THE FARMS

The part-owner operators farmed more parcels of land and had larger farms than either the tenants or owner-operators (table 2). The owner-operators' farms were the smallest of the three groups. For all farms the average farm area was 2.73 hectares, of which 44.3 per cent was lowland.

TABLE 2.—*Characteristics of the farms*

ITEM	AVERAGE TO A FARM			
	Tenant	Part-owner	Owner	All farms
Lowland	1.1	1.8	.8	1.2
Other fields	1.4	1.2	.8	1.3
Coconut plantation	.1	.3	.3	.1
Firewood			.6	.1
Total	2.6	3.3	2.5	2.7
Number of parcels	2.2	2.9	1.9	2.3

Size of farms. The farms varied in size as follows: tenant-operated farms, .60 to 10 hectares; partly owned farms, .25 to 6 hectares; owner-operated farms, 1 to 10 hectares (table 3).

TABLE 3.—*Size of farms*

AREA IN HECTARES	TENANT		PART-OWNER		OWNER	
	Number	Per cent	Number	Per cent	Number	Per cent
0.60–2.50	40	66	8	42	10	76
2.60–3.50	11	18	6	33	1	8
3.60–4.50	1	2	1	5	1	8
4.60–5.50	6	9	1	5	0	0
5.60–6.50	2	3	3	15	0	0
6.60 and above	1	2	0	0	1	8

Use of land and yields. The part-owners had a larger effective crop area than the tenants and owners (table 4). Their crop area was about double that of the owners.

TABLE 4.—*Utilization of effective crop area*

CROP	HECTARES TO A FARM			
	Tenant	Part-owner	Owner	All farms
Lowland rice	1.1	1.8	.8	1.2
Upland rice	1.2	1.0	.7	.1
Vegetables and minor crops	.1	.1	.1	
Coconut	.1	.3	.2	.1
Total	2.5	3.2	1.8	2.4

Rice was the principal crop grown by all the farmers. No fertilizer was used. The average area planted to rice was 2.3 hectares, of which 1.2 hectares were planted to lowland rice. The yield of lowland rice averaged 28 cavans per hectare a year (table 5).

TABLE 5.—*Rice yield*

RICE CROP	CAVANS PER HECTARE			
	Tenant	Part-owner	Owner	All farms
Lowland	27.3	30.9	28.2	28.1
Upland	17.4	23.1	15.4	18.2

Upland rice yields were about two-thirds of those of lowland rice yields. The partly owned farms had a higher yield per hectare than the tenant-operated farms, and those operated by owners had the lowest.

The minor crops grown were corn, sitao, gabi, eggplant, and coconut. Eggplant and coconut, being in great demand in this area, were planted in larger quantities than the other minor crops.

Capital investment. For all farms the average capital investment was ₱10,279 (table 6). Most of the investment was in land which, in the case of the tenants and part-owners, belonged partially or wholly to the landlord. The largest investment in buildings was made by part-owners.

TABLE 6.—*Capital investment to a farm*

ITEM	PESOS TO A FARM			
	Tenant	Part-owner	Owner	All farms
Land	7,720	10,985	8,423	8,486
Buildings	827	1,168	824	986
Work animals and other livestock	579	703	530	597
Tools	142	181	119	147
Seeds and supplies	61	83	44	63
Total	9,329	13,120	9,940	10,279

Carabaos were used as work animals on all farms. The average number to a farm was 1.5, and this represented about 75 per cent of the livestock investment. Chickens, ducks, swine, and a few cattle, horses, and goats were found on the farms.

The tools were furnished by the farm operators. Part-owners had the highest average investment in tools of the three groups. This corresponded to their larger area farmed. The principal tools were the plow and harrow (table 7).

TABLE 7.—*Number and value of tools*

TOOL	TENANT		PART-OWNER		OWNER	
	Number	Value	Number	Value	Number	Value
		pesos		*pesos*		*pesos*
Plow	1.54	76.07	1.79	95.26	1.15	51.15
Harrow	1.30	33.48	1.32	43.32	1.00	23.62
Hoe	0.77	2.81	1.11	3.30	1.23	4.62
Bolo	1.82	7.40	2.79	9.61	2.31	8.58
Sled	0.48	6.70	0.58	9.89	0.46	5.54
Cart	0.03	4.59	0.11	4.47	0.08	3.85
Rake	0.49	1.20	0.68	1.97	0.69	1.88
Basket	1.44	0.88	1.37	1.91	1.15	1.09
Harvest tools	2.26	1.38	2.58	1.73	2.31	1.77
Carpentry tools	2.08	7.97	2.58	9.43	31.54	16.54
Total		142.48		180.89		118.64

The part-owners furnished most of the supplies. Sometimes the landlord furnished the seeds, depending on the method of sharing followed.

LANDLORD–TENANT ARRANGEMENTS

The landlords were related to 21 per cent of the tenants and 37 per cent of the part-owners (table 8).

TABLE 8.—*Landlord–tenant arrangements*

ITEM	PERCENTAGE OF	
	Tenants	Part-owners
Tenants related to landlord	21	37
Tenants with written agreements	7	11
Tenants who borrowed from landlord	16	11
Tenants with share rentals	98	95

There were four tenants and two part-owners with written agreements with their landlords. In general, agreements were verbal and governed by the customs and traditions of the locality.

Ten of the tenants and two of the part-owners borrowed from the landlord. The loans from the landlord were usually paid at harvest time without interest. Two of the tenants paid interest at 12 per cent.

The prevalent type of renting was crop sharing. This was true for both tenants and part-owners. Only 2 per cent of the tenants and 5 per cent of the part-owners paid cash rental.

On all farms, rice was divided in the form of unhulled rice or palay. The sharing systems used were 1/3-2/3, 50-50, and 70-30 of the crop after seed had been set aside (table 9).

TABLE 9.—*Sharing arrangements*

ITEM	PERCENTAGE OF	
	Tenants	Part-owners
Method of sharing rice:		
⅓–⅔	52	17
50–50	46	72
70–30	2	11
Place of division:		
Rice field	97	100
Storehouse	3	—
Unit of measurement:		
Kerosene can	92	100
Ganta	8	—
Division made after harvesting	100	100
Seeds set aside before division	100	100
Seeds stored by tenant	94	90
Tenants not drying palay for landlord	97	100
Palay sacked before delivery to landlord	95	100
Landlords present at harvest time	100	100
Tenants not delivering palay to landlord	61	47
Landlords dictating policies on operations	98	100

The crop was usually shared in the field after harvesting. However, there were times when the crop was divided in the landlord's storehouse.

A high percentage of the tenants and part-owners did not dry the palay for the landlord. Sixty-one per cent of the tenants and

TABLE 10.—*Method of sharing rice crop expenses*

EXPENSE	PERCENTAGE FURNISHED BY					
	50-50		33-67		70-30	
	Tenant	Landlord	Tenant	Landlord	Tenant	Landlord
Seed	43	57	95	5	98	2
Fertilizer	84	16	78	22	100	—
Planting labor	13	87	78	22	100	—
Repair of dikes	100	—	100	—	100	—
Seedbed preparation	100	—	100	—	100	—
Weeding	95	5	93	7	100	—
Pest control	100	—	100	—	100	—
Guards for fields	100	—	100	—	100	—
Disposal of straw	100	—	100	—	100	—
Hauling of palay	100	—	100	—	100	—
Cash for harvesters	50	50	72	28	98	2
Food for laborers	100	—	100	—	100	—

47 per cent of the part-owners did not deliver palay to the landlord's storehouse.

The method of sharing the expenses differed in the 50-50, 1/2-2/3, and 70-30 bases of sharing the rice crop (table 10).

OWNER–OPERATOR ACQUISITION OF LAND

The land operated by the owner-operators was acquired by purchase, by inheritance, or by marriage (table 11).

TABLE 11.—*How land was obtained*

ITEM	OWNERS		PART-OWNERS	
	Number	Per cent	Number	Per cent
Method of acquiring the farm:				
By purchase	3	23	7	37
By inheritance	9	69	12	63
By marriage	1	8	—	—
Farm was purchased from:				
Relatives	1	33	4	57
Farmers	2	67	2	29
Others	—	—	1	14
Financed mostly by:				
Savings	1	33	7	100
Others	2	67	—	—

Of the farms which were purchased the highest percentage was purchased from relatives. Most of them were bought with savings.

STANDARD OF LIVING OF OPERATORS

The mode of living in the three groups differed only slightly (table 12). The tenants, the part-owners, and the owners had almost similar facilities in their houses. In general, the water supply and the lighting facilities were inadequate on all farms especially those of the tenants.

FARMERS' ATTITUDE TOWARD TENANCY

The attitude of owner-operators toward tenancy was similar to that of the other types of operators (table 13). Sixty-one per cent of the tenants, 63 per cent of the part-owners, and 62 per cent of the owner-operators had not considered cash renting. Sixty-one per cent of the tenants, 21 per cent of the part-owners, and 69 per cent of the owner-operators had not considered buying a farm, the main reason being lack of funds. In general, more of the part-owners preferred cash renting and buying of the farms than the tenants. This is probably due to the tenants' lack of funds to pay cash rent.

In the majority of cases the operators attributed the low yields and income to lack of irrigation facilities.

TABLE 12.—*Standard of living of operators*

ITEM	PERCENTAGE OF		
	Tenants	Part-owners	Owners
Farmers without radio	95	95	85
Kind of lights:			
Electric	10	26	15
Kerosene	90	74	85
Source of water—water system:			
Owned	20	63	31
Neighbor	54	37	54
Public utility	26	—	15
Kind of house:			
Walls:			
Wood	64	68	85
Bamboo	20	16	15
Nipa	8	5	—
Others	8	11	—
Roof:			
Cogon	16	16	15
Galvanized iron	67	79	85
Nipa	17	5	—
Floor:			
Wood	21	68	23
Bamboo	79	32	77
Movie attendance a month for farmer:			
Once	44	32	23
Twice	23	26	15
Three times	5	11	—
Four times	15	21	39
None	15	10	23

TABLE 13.—*Attitude of farm operators toward tenancy*

ITEM	PERCENTAGE OF		
	Tenants	Part-owners	Owners
Farmers who considered cash renting	39	39	38
Farmers desiring to own farm now operated	98	100	—
Landlord giving special privileges to tenants	8	—	—
Farmers giving farm same care as if owned	79	63	—
Farmer able to buy farm at present sale value	20	58	—
Complaint of farm operators against arrangement:			
Landlord does not furnish seeds and expenses	5	16	—
No complaint	95	84	—
Suggestions of farm operators to improve tenancy situation:			
Use irrigation system and apply right amount of fertilizer	57	74	62
Distribute land equally among tenant farmers	2	5	—
Improve sharing method and credit facilities	10	5	—
Improve palay varieties	2	—	—
No suggestion	29	16	38

THE INFLUENCE OF NITROGENOUS FERTILIZERS ON THE pH AND EXCHANGEABLE BASE STATUS OF CERTAIN COFFEE AND CITRUS SOILS [1]

N. L. Galvez, T. C. Cruz, N. C. Brady, and P. A. G. Santos

WITH ONE TEXT FIGURE

Ammonium sulfate or ammonium phosphate applied at rates to supply 12.8 grams of nitrogen to a tree every two months drastically reduced the pH and exchangeable calcium and magnesium of a sandy loam soil immediately around the coffee trees. As much as 50 per cent of the exchangeable calcium and 75 per cent of the exchangeable magnesium were lost from the upper 10 centimeters of soil. Lower pH values and exchangeable calcium and magnesium were also obtained under the trees of seven citrus farms than between the rows. On both the citrus and coffee soils acidification increased the exchangeable manganese but had an inconsistent effect on the exchangeable potassium and sodium and on the available phosphorus.

Soil pH determinations run on samples taken at different depths and distances from the tree trunks indicated significant acidification around the trees. Average pH values as low as 4.31 were found in the surface soils. Indications were that some soils were acidified below the 45-centimeter layer.

The cation exchange capacities of both the coffee and citrus soils were relatively high, the range in milliequivalents per 100 grams soil being from 21.0 to 27.0 for the coffee soil and from 25.8 to 33.0 for the citrus soils. Even though these values indicate a high buffering capacity or a resistance to change in pH, fertilizer application resulted in significant increases in soil acidity.

Nitrogen-containing fertilizers are essential for the optimum production of most upland crops grown in the Philippines. This fact has been shown by field experiments and is recognized by farmers throughout the country, particularly those who are concerned with cash crops such as sugar cane, abaca, coffee, pineapple, and citrus.

Since ammonium sulfate supplies nitrogen more cheaply in the Philippines than do the other usable solid forms, it is generally the most widely used source of nitrogen. As with most ammonium-containing fertilizers, however, ammonium sulfate has a tendency to acidify soils, especially if frequent large applications are made.

Numerous investigations have shown the effect of nitrogenous fertilizers on soil acidity and on the loss or gain of exchangeable bases. Early lysimeter studies indicated clearly that ammonium salts increase the soil acidity and the loss of exchangeable bases from soils (Eckart, 1906; Collison and Walker, 1916). Allison and Cook (1916), Blair and Prince (1924), Lipman and Prince (1920), Morse (1917), Veitch (1906), Beling (1931), and Baver (1926)

[1] Central Experiment Station Contribution No. 1833.

were among the investigators who observed that ammonium sulfate increases the acidity of the soil, whereas nitrate salts generally decrease it.

The classical research of Way (1850-1852) has pointed out that the biochemical process of nitrification takes place in well-aerated soils to which a salt such as ammonium sulfate has been added. That this process results in the formation of two strong acids, sulfuric and nitric, was emphasized by several researchers—Frear (1915), Ames and Schollenberger (1916), Page (1927), and Kappen (1927).

The potential acidity of nitrogenous fertilizers is not limited to the ammonium-containing compounds. Material like urea first increases soil pH from 6.4 to 7.6. After nitrification, soil pH decreases to 5.35 (Brioux, 1931). Cottonseed meal has also been shown to have a definite but much smaller acidifying effect than ammonium sulfate (Blanck, 1931; Pierre, 1928; Swanback and Morgan, 1930; Morgan *et al.*, 1942).

Galvez and Bueno (1951), however, found that ammonium sulfate had no significant effect on the pH of soils on which lowland rice was grown.

Fertilizer practices for several crops grown in the Philippines involve the annual usage of ammonium nitrogen in relatively large quantities. The effect of this fertilization on soil acidity has not been determined under Philippine conditions, hence this study on the influence of ammonium-containing fertilizers on the pH and exchangeable bases of certain coffee and citrus soils.

MATERIALS AND METHODS

Soil samples were taken from a fertilizer experiment comparing two sources of nitrogen applied to young *Coffea arabica* seedlings. The experiment was conducted by Mr. Juan Ledesma on his plantation at Matutum, Cotabato, in cooperation with representatives of the Philippine Packing Corporation.[2] The soil on which the experiment was run is a sandy loam which developed on a light-colored parent material, apparently volcanic ash from Mt. Matutum.

The fertilizer experiment had been in progress for a little over a year when the samples were taken on June 20, 1954. The following plots were sampled: (a) cleck plot—no treatment; (b) ammonium sulfate plot—62 grams to a tree every two months; (c) ammonium phosphate plot—80 grams to a tree every two months. The two fertilizer treatments were chosen since they had the same amount of nitrogen and produced large, green, and healthy trees. The fertilizer had been applied around each tree approximately 1 foot from the base.

[2] Thanks are due to Mr. Robert Leavitt of the Philippine Packing Corporation and to Mr. Pedro Chiangco of the Matutum Agricultural Development Corporation for their help in collecting and sending the soil samples to the College.

Each plot in this experiment was planted to a single row of 12 trees. Two samples of surface soil were taken from each plot. One sample was a composite of 12 subsamples which were taken approximately 25 centimeters from the base of each of the 12 seedlings. Paired subsamples were also taken 1½ meters from the base of each of the 12 trees. These were composited to get the second sample from each plot. Samples were taken from four replications of each of the three treatments. By this sampling procedure the fertilized and unfertilized soils could be compared. The samples were taken from the surface soil (upper 10 cm.) only because the influence of the fertilizer was expected to be at a maximum in this zone.

The samples were taken to the laboratory, dried, and passed through a 2-mm. sieve. The pH, organic matter, cation exchange capacity, exchangeable Ca, Mg, Mn, K, and Na were determined by the methods of Peech *et al.*[3] Sodium was determined in the extract by the total chloride method, and extractable phosphorus, by the method of Truog (1930).

Six citrus groves in Batangas and one in Laguna were chosen for this study (table 1). The fertilizer history of each farm is given in table 2. Two groups of soil samples were taken from each of the farms, one for an exchangeable cation and pH study and the other for a pH distribution study.

For the exchangeable cation and pH study, paired surface soil (0 to 15 cm.) subsamples were taken near each of 24 trees, one within a meter of the tree base and the other midway between the rows. The 24 subsamples from each location were composited. The same procedure was followed in the lower and upper portions of a given field so that soil areas which varied in their susceptibility to leaching could be compared. A total of four samples were therefore taken from each farm. The samples were also analyzed like the coffee soil samples.

Soil samples for pH distribution study were taken near the five oldest trees selected at random on a given farm. The ages of the trees are given in table 1. Samples were taken at 15-cm. intervals in a horizontal direction from the tree trunk to a distance of 150 cm. Each boring was 7.5 cm. deep. At the same horizontal distances, samples were taken from the next 7.5-cm. layers until a depth of about 45 cm. had been reached. Ten samples were taken from each 7.5-cm. layer, and since there were six 7.5-cm. layers, a total of 60 samples to a tree was accumulated. Each farm had 300 samples except farm No. 2 which had 250 samples. pH determinations were made on a 2:1 water to soil ratio using a Beckman Model M pH meter.

[3] M. Peech, L. Alexander, and L. Dean, *USDA Cir.*, 757 (1947).

RESULTS AND DISCUSSION

Matutum coffee soil studies

The pH values of samples between rows of the fertilized plots were identical with one another (table 3), strongly suggesting that the area under study has a uniform acidity. As was expected, the pH values of all the samples collected 25 cm. from the tree were significantly lower than those between rows. Of these values, the difference from the control was the least, being only 0.20 pH unit. Kappen and Bergeder (1926) observed a similar tendency of soil reaction when soil was cropped. On the other hand, the ammonium sulfate (20-0-0) and ammonium phosphate (16-20-0) plots showed much higher values. The difference between samples collected between rows and those collected 25 cm. from the trees was more than 1 pH unit, which is about six times as much as in the control. Assuming that 0.20 pH unit is the acidity developed by coffee plants in the upper 10 cm. of soil in this short period of time, the net decrease of about 1 pH unit in the fertilized lots is evidently attributable to the added nitrogenous fertilizers.

Furthermore, the soil immediately around the trees had a pH as low as 4.51, which is much lower than the accepted optimum for most crop plants. It is interesting to note that the ammonium phosphate fertilizer had essentially the same influence as ammonium sulfate. This is not in agreement with the claim of some fertilizer dealers that sulfate of ammonia is the only nitrogen fertilizer which increases soil acidity. The effect of ammonium phosphate as reducing the pH of soils was also reported by Pierre (1928) and Kappen and Bergeder (1926).

Although the amount of extractable phosphorus was apparently variable (table 3), no definite trend of values was suggested.

The cation exchange capacities were higher than would be expected for a sandy loam soil, being from 21.0 m.e. to 27.0 m.e. per 100 grams soil (table 3). This is undoubtedly due to the high organic-matter contents since the low clay fraction of the soil would contribute relatively little to its total adsorptive capacity.

Unlike the pH, the cation exchange capacities of the samples collected between rows were not uniform in value, the control having the lowest and the ammonium sulfate plots the highest. The values of the samples collected 25 cm. from the trees were for practical purposes as much as those of the corresponding samples between rows.

Of the exchangeable cations determined, Ca had the highest amount, followed in descending order by Mg, Na, K, and Mn.

In the treated lots the exchangeable calcium and magnesium levels were also significantly reduced by the nitrogen fertilization. Nearly one-half of the exchangeable calcium and three-fourths of the exchangeable magnesium were removed from the surface soil. If

the rate of removal of exchangeable magnesium in subsequent years is as great as it was the first year, a nutrient deficiency might soon be expected.

The seriousness of this nutrient loss becomes more apparent when it is considered that the coffee trees in this experiment were only young seedlings which undoubtedly needed less nitrogen for optimum production than the large bearing trees. It seems probable that nutritional difficulties may occur in the future if heavy nitrogen fertilization is continued.

The exchangeable manganese level was significantly increased by the fertilizer treatments as was expected since manganese is generally more soluble under highly acid conditions. In fact, the detrimental influence of highly acid soils on plant growth has been attributed by several workers to manganese toxicity (Schmehl *et al.*, 1950).

There was considerable variation of potassium and sodium from replication to replication. In all plots, however, the average exchangeable potassium values were lower under the trees than between the rows. The treatments had no consistent effect on the exchangeable sodium content of the soil.

In the present investigation only the upper 10 centimeters of soil was sampled. In spite of this limitation, however, the data obtained are of some practical importance.

Citrus soils studies

Exchangeable cations and pH study. Data obtained from paired samples taken from under the trees, about 1 meter from the trunk, and between the rows of trees in both the upper and lower portions of the fields were averaged to give the data in table 4. In all cases, the pH values of the soil under the trees were lower than those of the soil between the trees. The difference was greatest for farm No. 2 and least for farm No. 7. Fertilizer had been applied to farm No. 7 for the last two years. On farms No. 2, 3, 5, and 6 the pH values under the trees were less than 5.0. These values are lower than those generally considered favorable for the growth of most crops.

The available phosphorus values were generally somewhat higher under the trees than between them. This may have been due sometimes to the deposition of phosphorus-containing organic matter from the relatively deep-rooted trees. On farms No. 2, 3, 4, and 7, however, the increase was attributed to the phosphorus fertilizer which had been added.

The cation exchange capacities were fairly high, ranging from 25.8 to 33.3 milliequivalents per 100 grams of soil. Such soils are expected to be highly buffered and to resist changes in pH. The cation exchange capacities under the trees were about the same as those between the rows of trees.

As might be expected, the reduction in pH was generally accompanied by a decrease in exchangeable calcium and magnesium. The soils under the trees were as much as 39 per cent lower in exchangeable calcium (farm No. 6) and nearly 30 per cent lower in exchangeable magnesium than the soils between the trees. Again the differences were less for farm No. 7 to which less fertilizer had been applied.

The differences in exchangeable potassium and sodium were not consistent from farm to farm. On farms No. 1, 3, 4, and 7 the exchangeable potassium values were lower under the trees. The reverse of this was true on farms No. 5 and 6, whereas no difference was noted on farm No. 2. The exchangeable sodium showed a similar variability. These observations are not easy to explain with the facts available.

As in the coffee soil, exchangeable manganese was higher in the more acid soils. It was higher under the trees in all the farms except in farm No. 7 where the soil pH had been reduced by only 0.43 pH unit.

Evidence in the present study does not show that fertilizer applications were the only causes of the reductions in pH and exchangeable calcium and magnesium under the citrus trees. It may be contended, for example, that citrus culture *per se* might have resulted in some of the changes noted. Sprays commonly used in the control of insects and diseases might have had some residual acidifying effects. When the previous results of numerous investigators are considered, however, the nitrogenous fertilizers applied to the citrus groves do seem responsible for a major portion of the changes in acidity and base status.

Soil samples under and between trees showed about the same amount of organic matter. This is not surprising since in most citrus orchards the growth of grass, weeds, and other cover crops is expected to help maintain the level of organic matter.

Even though these soils vary in texture from silty clay loam to clay loam,[4] (table 1), their organic-matter contents are much lower than that of the sandy loam coffee soil at Matutum. It may be of interest to mention here that these soils had been under cultivation long before citrus trees were planted on them. While the citrus trees were still nonbearing, the areas between the plants in some farms were planted to corn, rice, and other cash crops. Mention should also be made of the fact that the citrus soils developed from volcanic tuff rather than from volcanic ash.

As was pointed out earlier, half of the samples from a given farm were taken from the upper ridges and half from the lower areas so that the soil areas could be compared as to susceptibility to leaching. The pH and exchangeable calcium, magnesium, and

[4] Dr. M. G. Cline, Cornell visiting professor of soils, made the field determinations.

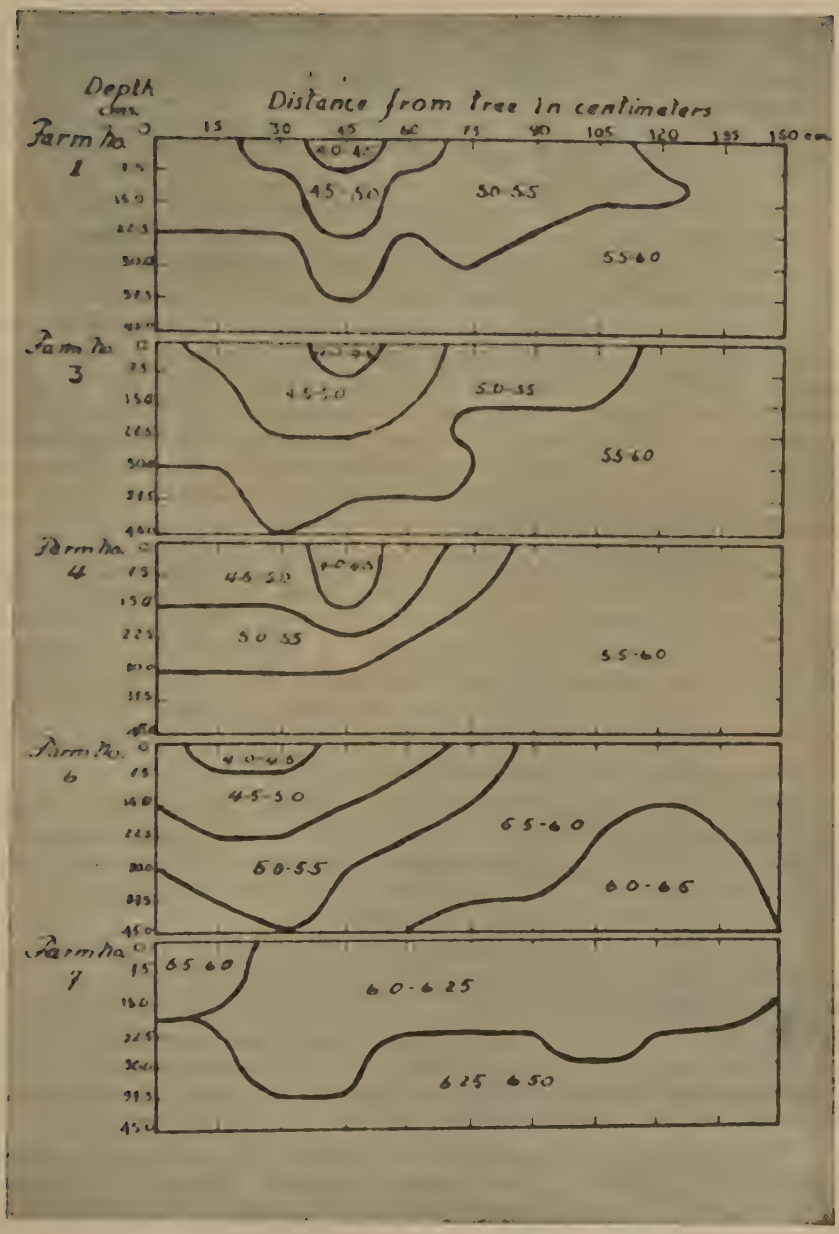

Fig. 1.—pH distribution on farms No. 1, 3, 4, 6, and 7.

potassium in the upper and lower portions of the field showed no consistent differences. On farms No. 2, 4, and 5 exchangeable calcium was lower in the lower area than in the upper area. The opposite was true on farms No. 3 and 6. No differences were noted on farms No. 1 and 7. Similarly inconsistent results were obtained for exchangeable magnesium.

The soils will have to be carefully characterized before these results can be explained.

pH distribution study. The variations in pH because of depth and distance from the citrus tree trunk are shown in figure 1. Each point was an average of determinations from different trees on farm No. 2 and from five different trees on all other farms.

With the exception of the soil in farm No. 7 all soils were distinctly more acid near the trees than they were a meter and a half away. Furthermore, the acidification tendency extended to a depth greater than 15 centimeters on all six farms. On farm No. 6, this tendency was noted below the maximum depth of 45 centimeters. Farms No. 2 and 5, which are not included in figure 1, showed a similar trend. On all farms, however, the lowest pH values were obtained in the surface layers.

Minimum pH values were found in the upper 7.5 centimeters of soil approximately 45 centimeters from the trunks of the trees on farms No. 1 and 3. Farm No. 2, which was not included in figure 1, indicated a similar pH curve. Similar values were found in the surface layers about 30 centimeters from the tree trunks on farms No. 4 and 6 and 15 centimeters away on farm No. 7. Farm No. 5 exhibited an identical trend of results. Average pH values as low as 4.31 were obtained on farm No. 2.

The computed and tabulated F values for vertical variation show a highly significant variation of pH on all farms sampled (table 5). A similar highly significant variation with horizontal distance was found on all farms except farm No. 7 which had been fertilized only for the past two years.

It should be pointed out that on all but one of the farms investigated, fertilizer had been applied for only four to five years. Even so acidification of the soil to a depth of at least 45 centimeters was noted. Although citrus roots undoubtedly go deeper than the 45-centimeter layer, continued acidification of the upper layer will likely limit citrus production since considerable nutrient absorption takes place in the upper layers of the soil.

The question of a practical remedy for the acidifying effect of ammoniacal fertilizers immediately arises. Ground limestone or "montecal" can and probably should be applied to soils which have become very acid. So-called "neutral fertilizers" can also be used. These contain a sufficient quantity of dolomitic limestone to neutralize the acidifying tendency of the ammonium salts. The second remedy is considered less practical than the former because the

limestone in the fertilizer generally costs the grower much more than the limestone applied in bulk.

Further research is needed before the practical importance of the acidifying tendency of ammonium salts under Philippine conditions can be gauged. The influence of the addition of limestone to acidified coffee and citrus soils must be determined. The acid tolerance of coffee and citrus and other crops will determine to a large degree the significance of the data from this investigation.

CONCLUSION

In the coffee and citrus fields where the soil samples were collected, ammonium sulfate and ammonium phosphate fertilization greaty increased the hydrogen-ion concentration. If the present method of using ammonium-containing fertilizers is not modified and if liming materials are not occasionally added, it will not be very long before the plants suffer both from soil Ca, Mg, and K deficiency and manganese toxicity.

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TABLE 1.—*Location and description of citrus farms from which soil samples were taken*

FARM NO.	OWNER	LOCATION	AREA	AGE OF TREES IN YEARS		DISTANCE OF PLANTING	SOIL TYPE
				For characterization	For pH distribution		
			ha.			*meters*	
1	Feliciano Leviste	Bugtong, Inisluban, Lipa, Batangas, Km. 78.	12.5	6	14	5	Silty clay loam
2	Felino Katigbak	Lipa, Batangas, Km. 88.5.	74	5	5	5	Clay loam
3	Fidel Reyes	Lipa, Batangas, Km. 90.0.	5	5	5	4	Silty clay
4	Eduardo Katigbak	Marauyo, Batangas, Km. 81.	25	5	5	5	loam
5	Feliciano Leviste	Pugon, Lipa, Batangas, Km. 83.	80	5	5	5	"
6	Feliciano Leviste	Mahabang-Parang, Inisluban, Batangas, Km. 80.	25	5	5	5	"
7	Amparo Exconde Tenalega	Lamot, Calauan, Laguna, Km. 78.	15	4	12	5	"

TABLE 2.—*Fertilizer history of the citrus farms from which samples were taken*

FARM NO.	YEAR	AGE OF TREES IN YEARS	KIND OF FERTILIZER	RATE OF APPLICATION
	1950	1	Ammonium sulfate	200 g./tree twice/year
	1951	2	" "	250 " "
1	1952	3	" "	300 " "
	1953	4	" "	400 " "
	1954	5	" "	500–600 "
	1953	14	" "	1500 g. every 8 months
	1950	1	" "	300 g./tree/year
	1951	2	" "	600 " "
2	1952	3	" "	1200 " "
	1953	4	" "	1500 " "
	1954	5	Ammonium phosphate	1000 " "
	1950	1	Ammonium sulfate	250 g./tree twice/year
	1951	2	" "	250 " "
3	1952	3	" "	250 " "
	1953	4	" "	250 " "
	1954	5	Superphosphate	500 " "
	1950	1	Ammonium sulfate	500 " "
	1951	2	" "	500 " "
4	1952	3	" phosphate	500 " "
	1953	4	" "	500 " "
	1954	5	" "	500 " "
	1950	1	Ammonium sulfate	200 " "
	1951	2	" "	250 " "
5	1952	3	" "	300 " "
	1953	4	" "	400 " "
	1954	5	" "	500–600 "
	1950	1	" "	200 " "
	1951	2	" "	250 " "
6	1952	3	" "	300 " "
	1953	4	" "	400 " "
	1954	5	" "	500–600 "
	1950	1	None	
	1951	2	None	
7	1952	3	Ammonium sulfate	200 g./tree/year
	1953	4	12–12–12	400 " "
	1954	12	None	

TABLE 3.—*Influence of fertilizer on characteristics of coffee soil from Matutum, Cotabato* [a]

TREATMENT AND LOCATION	SOIL CHARACTERISTICS								
	pH	P ppm	Exchangeable cations in m.e. per 100 grams soil						Organic matter in %
			C.E.C.	Ca	Mg	Mn	K	Na	
Control									
Between rows	5.79	28.05	21.0	5.72	2.49	.013	0.42	2.17	8.15
25 cm. from tree	5.59	71.50	21.0	6.22	2.36	.015	0.14	2.48	7.96
Ammonium sulfate									
Between rows	5.73	74.68	27.0	7.71	2.91	.013	0.50	3.14	9.47
25 cm. from tree	4.54	123.60	26.2	3.99	0.66	.058	0.11	1.99	9.27
Ammonium phosphate									
Between rows	5.77	60.94	23.2	6.54	2.64	.010	0.82	2.34	8.79
25 cm. from tree	4.51	58.74	25.3	3.07	0.64	.050	0.11	2.14	9.14
L.S.M.D. at 5% level	0.13	48.92	1.78	1.62	0.55	.011	0.29	N.S.	0.31

[a] Average of four replications.

TABLE 4.—*Chemical characteristics of soil samples taken under and between citrus trees*

FARM NO. AND LOCATION OF SAMPLES	SOIL CHARACTERISTICS								Organic matter in %
	pH	P ppm	Exchangeable cations in m.e. per 100 grams soil						
			C.E.C.	Ca	Mg	Mn	K	Na	
Farm No. 1									
Between trees	6.16	34	30.0	12.5	6.8	.01	1.23	1.77	2.4
Under trees	5.23	46	29.7	10.7	5.6	.04	.60	1.44	2.2
Farm No. 2									
Between trees	6.20	6	29.8	13.9	6.3	.01	.34	1.32	1.9
Under trees	4.62	9	26.9	11.3	4.5	.16	.33	1.64	1.8
Farm No. 3									
Between trees	6.15	15	30.2	14.6	6.7	.005	.59	.88	1.8
Under trees	4.75	54	25.8	10.5	4.7	.125	.32	1.43	1.9
Farm No. 4									
Between trees	5.91	48	33.3	15.1	5.6	.010	1.69	1.08	2.0
Under trees	5.26	83	28.6	11.7	4.7	.115	.102	.79	2.2
Farm No. 5									
Between trees	5.98	23	30.6	13.6	5.9	.02	.02	1.08	1.8
Under trees	4.84	31	29.3	9.7	4.6	.15	.96	1.08	1.8
Farm No. 6									
Between trees	5.92	38	31.9	13.6	6.2	.04	.06	1.36	2.2
Under trees	4.50	33	31.3	8.3	4.6	.32	.39	1.25	1.9
Farm No. 7									
Between trees	6.23	107	31.9	15.9	6.0	.005	1.27	2.01	2.9
Under trees	5.80	129	33.0	14.6	6.1	.005	1.04	1.64	3.0
L.S.M.D.	0.39	14.13	1.78	1.24	0.63	0.15	N.S.	N.S.	N.S.

TABLE 5.—*F-values for the horizontal and vertical sources of variation of pH distribution on citrus soils*

FARM NO.	F-VALUES FROM INDICATED SOURCE OF VARIANCE			
	Horizontal variation		Vertical variation	
	Computed	Tabulated [a]	Computed	Tabulated
1	18.33	3.14	45.66	4.56
2	124.75	3.14	82.75	4.56
3	56.75	2.94	59.25	4.10
4	57.75	2.94	56.00	4.10
5	84.00	3.14	36.80	4.56
6	111.40	2.94	69.60	4.10
7	3.00	3.14	86.00	4.56

[a] For 1% level of significance.

ABSORPTION OF CULTURE SOLUTIONS BY RICE SEEDLINGS [1]

J. R. Velasco, T. E. Cabrera, M. R. Vega, and F. T. Ramos

WITH ONE TEXT FIGURE

Rates of absorption of ions up to 30 days of age of the plants were generally higher than in the subsequent 30-day period. The proportions in which nutrient elements were absorbed by young rice plants varied considerably and were apparently influenced by environmental conditions. Ammonium nitrogen, potassium, and, presumably, nitrate nitrogen were absorbed in large quantities. Calcium, magnesium, and phosphate were absorbed in much smaller amounts.

A culture solution formulated to reflect the proportion in which ions were absorbed produced bigger plants than Espino's 4-salt solution.

In general the chemical composition of plants varies from species to species, suggesting that plants differ in the amount of nutrients that they absorb from the medium. It has also been observed that the need of a plant for a particular element varies with its stage of growth (Loehwing, 1953) and with certain factors of the environment (Broyer and Hoagland, 1943; Withrow, 1953).

All this information may argue against the undertaking of studies on nutrient absorption because of the uncertainty of the results and their subsequent value. However, it is hoped that repeated experiments and refinement of techniques may indicate in a broad way how absorption varies and the factors that influence the trend.

The study was conducted from 1953 to 1955. The preliminary work was mainly designed to develop the techniques of growing plants in culture solution and of analyzing for the different ions.

MATERIALS AND METHODS

Seeds of Elon-elon variety of rice were soaked in tap water for 24 hours, allowed to drain in a cool place for another 24 hours, then laid out to germinate on a 20-mesh cloth suspended over a pan of water. When the seedlings were 5 centimeters tall, they were transferred to the culture solutions. As soon as the plants were established in the culture solutions, usually after about one week, those of uniform size were selected for the study on nutrient absorption.

The technique of growing rice plants in culture solution was described in detail by Hsieh (1941).

In a typical experiment, 1 liter of Espino's 4-salt solution was transferred to a 1-liter beaker, and two rice seedlings were grown

[1] Central Experiment Station Contribution No. 1834.

in it. Another liter of solution from the same batch was transferred to a Florence flask which was stoppered to prevent loss by evaporation. This was later used for determining the original ion concentration in the culture solution.

At the end of the growth interval (five to seven days) the solution remaining in the beaker was measured. Then distilled water was added to it to restore the volume to 1 liter. This, together with the original solution, was analyzed for the different ions. The difference in amount of ions between the two solutions was the amount absorbed during the growth period.

The age of a plant in any growth interval was obtained by averaging its age at the start of the period and at the end. The average of the weights at the start and end of the period was also taken. The amount of nutrient absorbed per gram of fresh weight of the plant a day was obtained by dividing the amount of nutrient absorbed for the period by the product of the number of days in the period and the average weight of the plant. Thus, if a 1.481-gram plant consumed 1.752 mg. of nitrogen in the form of ammonium ion during an interval of six days, its rate of absorption was $1.752/(6 \times 1.481)$ or 0.197 mg. of ammonium nitrogen per gram of plant a day.

The different ions were determined according to the methods of Peech and English (1944). In the later experiments nitrate was not determined because brucine could not be secured locally. Since there is no rapid method of analysis for sulfate, this ion was not determined.

The blue color of phosphorus faded rather fast and readings had to be made within a limited time after color development.

EXPERIMENTS AND RESULTS

Preliminary experiments. On June 15, 1953, some plants were started in Espino's 4-salt solution, which is composed of the following:

Calcium nitrate	0.000375 M
Ammonium sulfate	0.000375 M
Magnesium sulfate	0.001 M
Potassium di-acid phosphate	0.000250 M

One liter stock solution of micro-nutrients consisting of 2.86 g. H_3BO_3, 1.81 g. $MnCl_2$, $4H_2O$, 0.222 g. $ZnSO_4$ $7H_2O$, 0.075 g. $5H_2O$, and 0.017 g. MoO_3 was made up. One milliliter of this solution added to 1 liter of the culture solution gave the following approximate concentration: 0.5 ppm boron, 0.5 ppm manganese, 0.05 ppm zinc, 0.02 ppm copper, and 0.01 ppm molybdenum. Iron was added every other day as a ferric chloride solution (½ per cent) at the rate of ½ milliliter to 1 liter of the culture solution. This amounted to about 0.86 ppm iron for each addition.

All the cultures in the succeeding experiments were given the same amounts of micro-nutrients and iron.

The plants were grown in 1-liter beakers until they were 51 days old. They were then transferred to 5-gallon cans where they flowered at 160 days of age.

It was found that potassium, ammonium, and nitrate ions were easily depleted in the culture solution. For instance, in the culture solutions in the third growth interval, lasting for seven days, the three ions were zero in the spent solution, whereas the rest of the ions were still fairly abundant (table 1). It is probable that these ions were exhausted long before the samples for analysis were taken. The computed rate of uptake could therefore have been greatly in error.

TABLE 1.—*Absorption of solution in 33 days*

ABSORBED ION	INITIAL CONCENTRATION IN PPM	FINAL CONCENTRATION IN PPM	MILLIGRAMS OF ELEMENT ABSORBED PER GRAM A DAY [a]
Ammonium	16	0	0.37
Potassium	10	0	0.24
Calcium	15	12.5	0.06
Magnesium	15	7.5	0.18
Nitrate	4	0	0.09
Phosphate	6	4	0.05
Water	1000 ml.	547.2 ml.	10.77 ml./g./day

[a] Average of four replications. The culture was started on June 15, 1953.

The amount of potassium was chosen as an index of when to change solutions. In the experiment started on October 23, 1953, potassium in the culture medium was analyzed every other day, and the solution was changed as soon as this ion dropped down to just a trace.

The rate of absorption of ammonium nitrogen was slow up to the age of 18 days (0.16 mg./gram/day); then this rate practically doubled at the age of 28 to 41 days (table 2). At 47 days, absorption dropped to its initial rate and decreased further until the plants were 54 days old.

TABLE 2.—*Rate of absorption of young rice plants of 1 liter of Espino's 4-salt solution* [a]

AGE IN DAYS	WEIGHT OF PLANTS IN GRAMS	MG. OF ELEMENT ABSORBED/GRAM FRESH WEIGHT/DAY					ML. OF WATER/ GRAM/DAY
		NH_4-N	K	Ca	Mg	P	
18	1.3	0.16	0.45	0.02	0.64	0.13	4.8
28	3.5	0.32	0.29	0.09	0.44	0.13	6.0
35	5.6	0.26	0.26	0.10	0.32	0.14	4.5
41	9.3	0.31	0.22	0.05	0.16	0	4.0
47	11.8	0.17	0.12	0.06	0.11	0.14	3.3
54	15.8	0.14	0.09	0.05	0.14	0.14	3.2

[a] This experiment and the subsequent ones were in quadruplicate.

Potassium up to 18 days was absorbed at a very fast rate (0.45 mg./gram/day) ; then at 28 and 41 days absorption dropped to about half the earlier rate, and at 47 to 54 days, to one-fourth.

Calcium, which was initially absorbed at a very low rate (.02 mg./gram/day), reached its peak of 0.10 mg./gram/day at 28 and 35 days, then dropped to half this rate at 41 to 54 days.

Magnesium, like potassium, was absorbed at a fast rate (0.64 mg./gram/day) in the early part of the experiment. From 41 to 64 days, absorption dropped to almost one-fourth of the early rate.

Phosphorus was absorbed at a fairly even rate of about 0.14 mg./gram/day throughout the experiment.

The peak of water absorption (6.0 ml./gram/day) occurred at 28 days of age. Then absorption gradually dropped so that at 54 days it was about half of the peak rate.

Except with phosphorus, the rate of absorption tended to drop as the plant grew older. This is not to say that the amount absorbed decreased but that the rapid increase in size of the plant far exceeded the increase in absorption.

It will further be noticed that there was no strict correspondence between the rate of water absorption and that of any of the ions. This may be taken as another indirect proof that ion absorption is not a passive process which is dependent on the transpiration stream.

A comparison of nutrient absorption showed that the elements were arranged in the ionic ratio of $4NH_4$-N 1.6 K: 0.4 Ca:3.2 Mg: 1.2 P. On the other hand, Espino's 4-salt solution had an ionic ratio among elements of 3 NH_4-N: 1 K: 1.5 Ca: 4 Mg: 1 P. There was a relative abundance of calcium and magnesium but insufficient ammonium and potasium in Espino's 4-salt solution.

On July 12, 1954, rice seeds were germinated and divided into two lots. One lot was grown in Espino's 4-salt solution and the other lot, in the modified solution in which the ratio of ions corresponded with their rates of absorption. After two weeks in the culture solution, the plants in the modified solution had stubby roots with necrotic tips, signs of calcium deficiency. The solution was further modified by increasing the concentration of calcium. The following compose the modified solution:

Calcium nitrate	0.000376 M
Potassium nitrate	0.00036 M
Ammonium sulfate	0.00054 M
Magnesium sulfate	0.00054 M
Potassium di-acid phosphate	.00018 M

Comparison of two culture solutions. On December 27, 1954, seeds were soaked in water and germinated. When the seedlings were 12 days old they were transferred to the culture solutions, two to every 200 milliliters of solution in 250-ml. culture bottles.

In general the plants in the modified solution (culture II) were healthier. At harvest, their leaves were 4.3 cm. longer than those in Espino's 4-salt solution (culture I) which were 45.5 cm. long, but on the average their roots, which were 11.0 cm. long, were 2.7 cm. shorter than the latter. The average number of tillers was 5.3 for the plants in Espino's 4-salt solution and 6.2 for those in the modified solution.

The plants in Espino's 4-salt solution were initially higher in average weight, but at 39 days those in the modified solution became heavier (table 3). The increase was maintained so that at 37 days of age, when the plants were harvested, culture I weighed 8.5 grams and culture II 12.4 grams.

TABLE 3.—*Absorption of ions by young rice plants planted December 27, 1954, in two culture solutions* [a]

AGE OF PLANTS IN DAYS	WEIGHT OF PLANTS IN GRAMS	MILLIGRAMS OF ELEMENT ABSORBED/GRAM/DAY						MILLILITERS OF WATER/ GRAM/DAY
		NH_4-N	K	Ca	Mg	NO_3-N	P	
Espino's 4-salt solution:								
15	0.509	0.182	0.08	0.23	0.24	0.263	0.020	2.8
22	0.995	0.206	0.05	0.11	0.03	0.134	0.053	4.4
29	1.481	0.197	0.27	0.12	0.08	0.105	0.045	5.8
34	2.111	0.167	0.23	0.07	0.04	0.088	0.036	4.3
39	3.032	0.070	0.16	0.06	0.07	0.062	0.012	3.5
Modified culture solution:								
15	0.440	0.208	0.32	0.14	0.05	0.570	0.023	5.1
22	0.766	0.323	0.50	0.22	0.01	0.327	0.047	6.5
29	1.295	0.287	0.38	0.10	0.10	0.229	0.043	8.9
34	2.113	0.211	0.37	0.04	0.03	0.168	0.022	5.9
39	3.362	0.012	0.29	0.03	0.02	0.109	0.045	4.9

[a] Volume of solution was 200 ml.

There was a higher rate of ammonium nitrogen absorption in culture II than in culture I. Both cultures had the same trend of absorption; that is, the rate was initially low, went up to a peak at 22 days of age, and then gradually subsided so that at 39 days it was considered negligible. This runs parallel to the observation in the preliminary investigation.

In contrast, nitrate nitrogen absorption started at a high rate and gradually came down. The ratio of nitrate to ammonium absorption in culture I was 0.8 to 1. In culture II, however, nitrate absorption was 1.4 times the ammonium absorption. It may be assumed that in this experiment the two ions were absorbed in about equal proportions.

The relative rates of ammonium and nitrate nitrogen absorption may be influenced by pH of the solution and age of the plant. Clark and Shive (1943) observed that with 41-day-old tomato plants ammonium absorption at pH 7 was twice that at pH 4. Nitrate absorption in older plants was not so greatly influenced by the pH of the

solution as in younger plants. With wheat seedlings, solutions containing ammonium alone increased in acidity, whereas those with nitrate alone decreased in acidity with absorption (Weissman, 1950).

Culture I had a low rate of potassium absorption (about 0.05 mg./gram/day) in the first 22 days. A peak of 0.27 mg./gram/day occurred at 29 days, and then absorption dropped to 0.16 mg./gram/day at 39 days. This does not confirm the earlier finding on potassium. The potassium absorption in culture II was higher and less fluctuating than in culture I—0.29 to 0.5 mg./gram/day. Toh and Galvez (1947) noted that maximum absorption of potassium by rice seedlings occurred at 16, 18, and 20 days. However, this information is hardly comparable with the present finding because the medium which Toh and Galvez used had a limited supply of potassium.

In both solutions, calcium absorption was 0.1 to 0.2 mg./gram/day during the first 29 days and 0.03 to 0.07 mg./gram/day thereafter. Again this observation runs counter to the earlier finding.

Magnesium absorption did not show any trend, probably because of the variability in the method of analysis for this ion.

The color of the magnesium lake in the original and in the spent solution usually differed, suggesting the interference of some other ion or ions. The absence of the ion in the spent solution or an alteration of its ratio with magnesium might have brought about the different color.

Phosphorus was fairly uniformly absorbed at 0.01 to 0.05 mg./gram/day.

Absorption of water was very similar to that in the preliminary experiment. In both cultures the peak of absorption was reached at 29 days. As a whole, more water was absorbed in culture II than in culture I.

The ratio of the elements absorbed were 5.2 NH_4-N: 1.9 K: 1.1 Ca: 1.9 Mg: 0.5 P; the ratio of these elements in culture I was 3 NH_4-N: 1 K: 1.5 Ca: 4 Mg: 1 P. In culture II, the amounts absorbed were 5.3 NH_4-N: 3.3 K: 0.8 Ca: 0.6 Mg: 0.4 P; the ratio in the original solution was 4.2 NH_4-N: 2.1 K: 1.4 Ca: 2.1 Mg: 0.7 P. In both solutions calcium, phosphorus, and magnesium were adequately supplied, but potassium and ammonium were not. With the exception of magnesium which had an unbelievably low absorption in culture II, the amount of the element supplied and that absorbed were closer to each other in culture II than in culture I.

A second comparison of the two culture solutions was started on March 5, 1955, in 1000 ml. beakers. The ratio of ion absorption was 6 NH_4-N: 2.8 K: 0.7 Ca: 0.2 Mg: 0.7 P in Espino's 4-salt and 3.8 NH_4-N: 3.6 K: 0.6 Ca: 2.2 Mg. 0.3 P in the modified solution (table 4). The plants in Espino's 4-salt solution gained 4.38 grams in 11 days, whereas those in the modified solution gained 6.20 grams during the same period.

TABLE 4.—*Absorption of ions by young rice plants planted March 5, 1955, in two culture solutions* [a]

AGE OF PLANTS IN DAYS	WEIGHT OF PLANTS IN GRAMS	MILLIGRAMS OF ELEMENT ABSORBED/GRAM FRESH WT./DAY						MILLILITERS OF WATER/ GRAM/DAY
		NH_4-N	K	Ca	Mg	NO_3-N	P	
Espino's 4-salt solution:								
23	0.73	0.85	0.87	0.42	0.04	—	0.27	29.9
29	2.39	0.45	0.87	0.08	0.02	—	0.09	15.2
34	5.11	0.24	0.28	0.04	0.02	—	0.04	11.5
Modified solution:								
23	0.79	0.59	1.80	0.34	0.90	—	0.16	33.2
29	2.66	0.42	0.82	0.16	0.19	—	0.04	15.8
34	6.99	0.22	0.65	0.07	0.10	—	0.01	10.8

[a] Volume of solution was 1000 ml.

When the plants were 23 days old, water was absorbed at 29.9 ml./gram/day in culture I and 33.2 ml./gram/day in culture II. The rate decreased as the plants grew older.

Data in all these experiments, although somewhat divergent, agree in emphasizing the need of young rice plants for great amounts of ammonium and potassium ions and relatively much less of calcium, magnesium, and phosphate ions. Although there was not enough information on absorption of the nitrate ion, it may be safe to assume that, like ammonium, nitrate is needed in great amounts. Galvez and Subido (1941), periodically analyzing rice plants at different ages, concluded that potassium was the highest absorbed of all the soil bases. The decrease in the amount of K_20 absorbed was abrupt as compared with those of Ca0 and Mg0. Absorption of these three bases was greatest during the seedling stage.

The phenomenal absorption of water at 23 days of age, which differed in trend from the previous two trials, called for verification. A trial was therefore conducted from April 13 to May 26, 1955. At 24 days of age, the rate of absorption for culture I was 48.8 ml./gram/day and for culture II, 30.6 ml./gram/day (table 5). The

TABLE 5.—*Rate of water absorption and change in pH of two culture solutions*

AGE OF PLANTS IN DAYS	WT. OF PLANT	ML. WATER/G./DAY	INITIAL pH	FINAL pH
Culture I:				
24	0.66	48.8	4.4	3.69
29	1.83	22.4	4.4	3.71
34	3.86	13.4	4.4	3.66
38	6.55	13.0	4.4	3.66
42	9.19	12.1	4.4	3.61
Culture II:				
24	1.21	30.6	4.7	4.3
29	2.98	21.9	4.3	3.8
34	5.92	13.0	4.4	3.62
38	9.55	11.8	4.2	3.5
42	14.08	11.5	4.5	3.64

rates gradually decreased as the plants grew older. The data essentially confirmed the findings in the fifth trial.

The changes in pH of the solutions were incidentally noted. Although there was more change in pH in culture I, the difference hardly merits consideration. The important observation seemed to be that there was an increase in acidity with absorption. This may suggest that more cation than anion was absorbed. Also, the accumulation of carbonic acid resulting from the respiration of the roots might have contributed to the lowering of the pH. The probability of carbonic acid accumulating in the solution is made greater by the fact that the solutions were not aerated.

The weights of the shoot and the root in the different trials are presented in table 6. The fresh weight of the shoot was from 1.5 to 2.8 times the fresh weight of the root. Culture II tended to be more succulent than culture I, as shown by the dry-to-fresh weight ratio. And, as may be expected, the root was more succulent than the shoot.

TABLE 6.—*Average fresh and dry weights at harvest of plants grown in two culture solutions*

TRIAL	CULTURE	FRESH WEIGHT		DRY WEIGHT		DRY-TO-FRESH WEIGHT RATIO	
		Shoot	Root	Shoot	Root	Shoot	Root
						1:	1:
Fourth	I	5.451	3.488	1.123	0.343	4.85	10
	II	8.204	3.924	1.616	0.438	5.10	9
Fifth	I	4.57	1.95	0.75	0.21	6.1	9.5
	II	5.95	2.51	0.91	0.21	6.55	11.9
Sixth	I	7.63	2.37	1.35	0.32	5.65	6.5
	II	12.01	4.69	2.02	0.52	6.00	9.

DISCUSSION

The fluctuations in the relative absorption of ions were conspicuous in the different trials. One probable cause was the varied atmospheric conditions from trial to trial. The first trial was started in June, 1953, the second in October, 1953, the third in July, 1954, the fourth in December, 1954, and the fifth in March, 1955.

Water uptake is a convenient example of the effect of atmospheric conditions on absorption. The rates of water absorption are graphically represented in figure 1. Lines Ia and IIa (fourth trial) represent absorption from 200 ml. each of the two culture solutions during the period January 8 to February 22, 1955. Plants in culture II had higher rates of absorption, but the peaks in both cultures were attained at the age of 29 days. Lines Ib and IIb (fifth trial) show that the rates of absorption from 1000 ml. each of the culture solutions were almost identical. The rates were exceedingly high compared with those of the previous trial. The period of observation was from March 26 to April 11, 1955. The mean

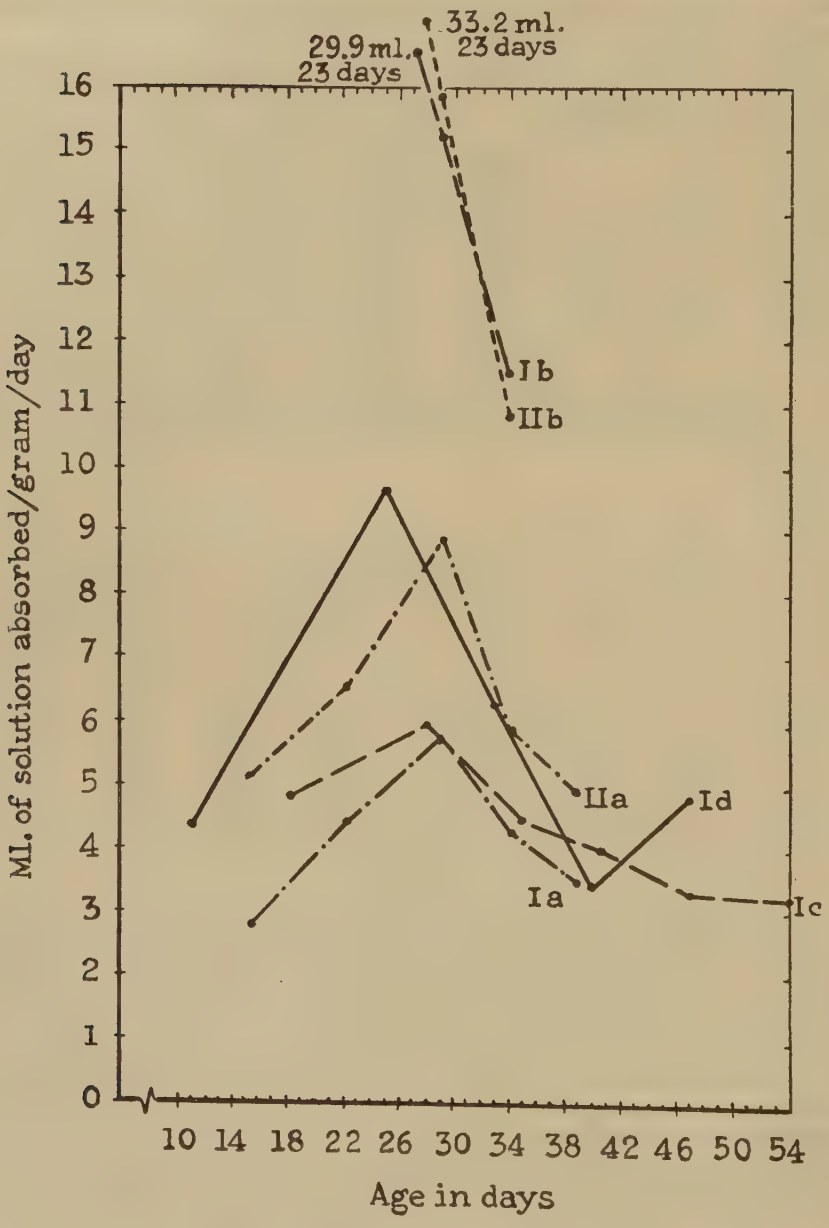

Fig. 1.—Rates of water absorption.

temperature was 27.4°C., and the relative humidity 64.2 per cent. In the previous trial the mean temperature was 25.5°C. and the relative humidity was 75.1 per cent.

It can be supposed that part of the high rate of water absorption in the second trial was due to the higher drying influence of the atmosphere. Another important factor on which precise data are lacking is sunlight during the two trials. The general observation is that during January and February the sky is usually overcast and the light period is short. In contrast, during March and April sunlight is intense and the light period is long. Long intense light is conducive to wide-open stomata and greater transpiration. It may further affect the plant in terms of more efficient photosynthesis, which, in turn, may directly or indirectly affect the rate of nutrient absorption and the ratio of the ions absorbed (Trelease and Livingston, 1924).

The relatively high absorption of ammonium, nitrate, and potassium ions and the lower absorption of calcium, magnesium, and phosphate attract attention. It is easy to relate the great need of plants for the two nitrogenous ions with the amino acids and proteins which form the bulk of living matter. But potassium is not identified with any stable constituent of plants. It has been assigned many physiological roles (Shepperd, 1951), but no conclusive proofs of these have been presented. Noguchi and Sugawara (1952) found that rice plants deficient in potassium have high activities of amylase, saccharase, oxidase, and peroxidase. With the application of potassium there was increased lignification of schlerenchymatous cells.

On the other hand, it is hard to reconcile the lower need for calcium with its important function in holding cells walls together, for magnesium with its part in chlorophyll, and for phosphate with its part in some nucleo-proteins and some energy carriers like adenosine triphosphate. With such a low absorption of phosphate, it may be wondered why phosphorus is considered a critical element at all.

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COLLEGE AND ALUMNI NOTES

As of June 20, 1955, the total enrollment figure at the College was 3,706, excluding the 300 or more cross-registrants from the College of Forestry and the 210 students at the UP Rural High School.

Old students and freshmen numbering 1,716 packed Baker Memorial Hall for the opening exercises on June 10. They were welcomed by the presidents of the Student Body Organization and the Associated Women Students. The opening remarks were delivered by Prof. Leopoldo Villanueva and the closing remarks by Acting Dean F. O. Santos. Choruses were rendered by the Aggie Men's Glee Club and the Faculty Ladies Ensemble.

US Ambassador to the Philippines Homer Ferguson, Senator Everett Dirksen of Illinois, and other American government dignitaries visited the College on June 9 and said they were very much impressed with the "good work" being done here. The visitors were accompanied around the campus by a group of professors led by Dr. F. O. Santos.

Eleven Vietnamese students arrived on the campus June 17, bringing the total number of Vietnamese FOA scholars to the College to 21. The three girls in the group enrolled in the Home Technology course and the rest, in the regular agricultural course.

Agriculture Undersecretary Jaime M. Ferrer visited the Central Experiment Station May 27 to observe at first hand test plots of the ordinary and Margate systems of rice planting. The tests involved two palagad rice varieties under lowland conditions and were conducted by the plant breeding division of the Department of Agronomy.

Professor A. B. Catambay, head of the agricultural engineering department, flew to the United States on May 16 to observe the latest trends in his field in various experiment stations. The FOA grantee will be away for six months.

Newest addition to the Cornell group at the College is Dr. Horst Von Oppenfeld. His appointment as visiting professor of agricultural economics was made possible through a grant of $34,000 by the Council of Economic and Cultural Affairs to Cornell University. Dr. Oppenfeld comes to the Philippines after a year of doing flower marketing research in the Department of Horticulture of the Michigan State University.

The Philippine Poultry Improvement Selecting Agent's Training School and Poultry Institute, sponsored yearly by the College and the Bureau of Animal Industry, was conducted from May 19 to 21 at the Poultry Husbandry compound. Lectures and demonstrations were given by the departmental staff.

In the Department of Agricultural Botany, personnel events included the appointment of Dr. Jose M. Capinpin as permanent head of the department, of Dr. Jose R. Velasco as research associate and professor of plant physiology, of Rollo K. de la Fuente and Juan C. Lusanea as assistant instructors, and of Pedro Llena and Eutropio Ochavillo as research assistants.

Vicente C. Lugod of the same department also changed his status when he married the former Gliceria C. Cajucom on April 28 in the Catholic church of Tayug, Pangasinan.

Teodoro B. Baguilat, Valentino Alipio, and Jesus Sta. Iglesia have joined the staff of the Department of Agricultural Economics as assistant instructors. Another new appointee is Leopoldo de Guzman, research assistant.

Prof. Roldan of the College of Forestry presented a paper on the degree of susceptibility of unscraped rattan poles, leached in running water at different lengths of time, to the growth of staining fungus at the 233rd meeting of the Los Baños Biological Club on June 24.

Delegates of the Southern Tagalog Annual Conference listened to Dr. Valente Villegas speak on livestock production on April 14 at the Christian Student Center.

Among the alumni, Dr. D. V. Villadolid, '23, director of fisheries, was elected vice-president of the Philippine Rural Community Improvement Society.

Mr. Albino P. Varona, '29, senior agricultural economist of the DANR Division of Agricultural Economics, left for the United States on a PHILCUSA-FOA training grant to study and observe methodology in agricultural economics research.

Mr. Jose P. Sto. Domingo, '33, superintendent of fabrication at the Talisay-Silay Milling Co., Inc., is on a tour of leading sugar producing countries of the world to observe new techniques and developments in the manufacture of sugar. His itinerary includes Hawaii, Cuba, United States, Puerto Rico, and Santo Domingo.

Mr. Eugenio E. Cruz, '25, was named director of the Bureau of Plant Industry.

Mrs. Paulina Demerry Pages, '43, received a Phi Sigma award in the Alpha Chi chapter for marked distinction in biological research.